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COMPOUND ARMOR PLATES.

For many years, as we need scarcely remind our readers, steel had not been seriously thought of as a material for armor plates. Having been repeatedly found to split under the impact of shot, steel had got entirely into disrepute; and although the question had been again raised by some of our English manufacturers, the government authorities had so thoroughly satisfied themselves on this head, that it seemed highly improbable that the expense of making a trial of this description would be incurred by them. It was the trial at Spezzia that opened our eyes to the fact that in some cases steel plates would, in the act of breaking, stop shot which would have completely passed through iron plates of the same thickness. The advantage of steel, however, was still very questionable for general purposes, for the same steel plate which compared so favorably with wrought iron under the fire of the 100-ton gun, broke and split to pieces under the salvos of guns which produced comparatively little effect on the iron plates. The question arose whether the power of stopping the single blow of a very heavy shot that would penetrate any other material was not too dearly purchased by the liability to rapid destruction under the repeated blows of comparatively small guns. Hence it was to meet a real want that Mr. Wilson brought forward his compound plates, consisting of steel and iron united together by fusion. In these plates the steel may split entirely through, but, being held to the wrought iron by the union of the two, still remains in its place as an effective shield against future blows. We have already given an account of the first trials of Wilson's plate at Shoeburyness; we notice it again in order to show the exact effect by means of the accompanying cut taken from a photograph, which explains the behavior of the compound plate better than words. The plate was 9 ins. thick, the area being about 3 ft. 7 ins. by 3 ft. 6 ins The face of it consisted of steel extending to a depth of 5 ins., the remaining 4 ins. being of wrought iron. This was fired at by a 7 in. gun at seventy yards distance, with a charge of 30 lbs. of powder, giving a striking velocity of 1,456 ft. per second to the projectile, whose weight is 115 lbs. This, if worked out, will be found nearly about a match for an unbacked plate of 9 ins. On firing, the shot's point penetrated to a depth of $3\frac{1}{8}$ ins. only, the plate being split across the face in five long radiating cracks,—*vide* Fig. 1. The back was very slightly bulged to the extent of about $\frac{1}{2}$ in. When the impression made by the shot's point was carefully examined, it was seen that instead of corresponding to the form of an unbroken shot, as is commonly the case in iron, it exhibited a series of segment-like jagged impressions round the central one made by the point, which indicate that the shot was broken directly on impact, the pieces coming in contact with the plate in succession. This was undoubtedly the case, the fragments flying away so far, and breaking into such small pieces, that only one or two were recovered. Clearly the plate, in addition to keeping this shot out, is but little injured as regards its future resisting powers, so long as the steel remains thoroughly united to the iron. On this union the efficiency of the plate mainly depends, for the starring or cracking of the steel would be fatal to the entire plate, and a greater evil than complete penetration, were the steel and wrought iron to separate. Attention has, of course, been specially given to this point. Fragments cut from the compound plate have been torn asunder, and have given way not at the junction, but through the metal about 1 in. from it, showing that the line of junction has not been the weak place. Fig. 2 shows the crack seen at the upper edge of the plate fired at, in which—Fig. 2—may be observed a crack parallel to the face, not however at the line of junction, but 1 in. further in the iron.

The action of this plate, then, was to break the shot while splitting and starring through its steel portion; but the latter was held together by the iron. Compound plates, made on a different principle, are being also sent in for trial on board the Nettle; but the description of these we reserve for our report on the fuller experiments. The value of all depends on the union by fusion of the steel and wrought iron. This is so important a matter that we herewith give illustrations showing the general construction of the furnaces used by Mr. Alexander Wilson, and described in his patent, of which we now give a brief sketch. The plates are placed horizontally in a furnace when a steel plate is to be cast on to a single iron one, but when a wrought iron plate is attached both to the front and back of a steel one the two iron plates are fixed vertically, and the steel run in between them. Figs. 3, 4 and 5 show the furnace and plates on the former system; Figs. 6, 7 and 8 the latter.

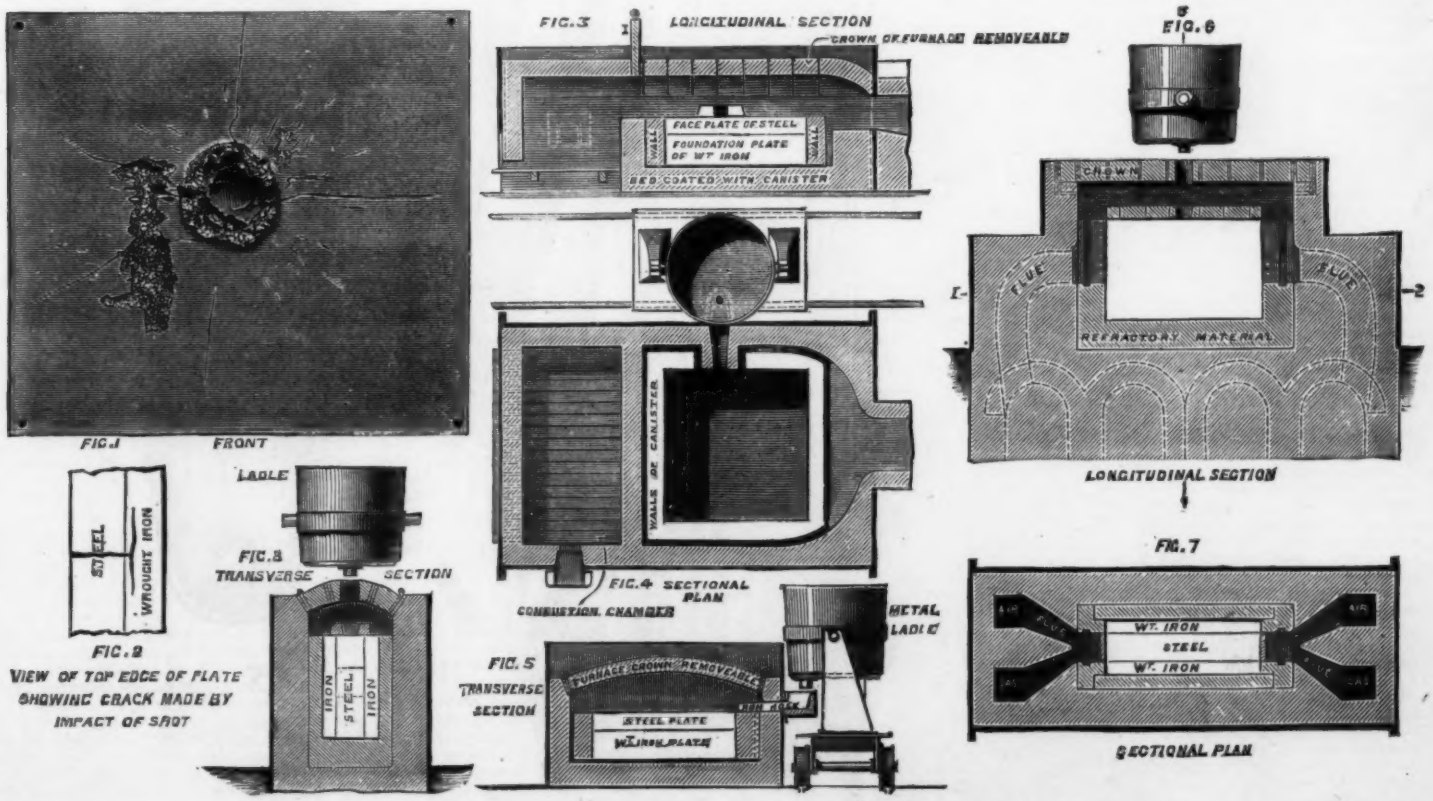
On the first-mentioned plan a wrought iron—or, if desired, a very soft steel plate—termed a foundation plate—is placed in a receptacle or mould of canister, its edges being protected, as shown in Figs. 3 and 5. After it has been raised to a welding heat the steel is run from the ladle through the run-hole to the desired thickness, when the combustion chamber of the furnace is dampered off, and the crown of the furnace removed, to allow of the introduction of a chill plate, which hardens the surface, besides preventing the action of the air on the molten metal. The steel afterward has a fiber imparted to it by the action of rolling mills. In place of the above arrangement the foundation plate is sometimes placed on a bogie or loose furnace bottom, which enables it to be withdrawn to receive the chill plate.

The foundation plate may be faced if preferable by melting pieces of refined iron, steel, or hard metal on it until the required thickness be obtained. Trial is also being made of steel plates with tough face and back—that is, steel sandwiched between two wrought iron plates. This construction requires, as noticed above, another kind of furnace, in which the plates are placed vertically. This is shown in Figs. 6, 7 and 8. In these it will be seen that the wrought iron plates are fixed with the interval for the steel left between them, the metal being run in after the wrought iron has been brought to welding heat by the flame obtained from the mingled gas and air supplied to the furnace alternately from the flues shown in Figs. 6 and 7. The metal is run in through a hole formed in a refractory brick in the crown of the furnace. The plates are afterward rolled out as in the former case. The curved form necessary for turret plates may be given to the steel by employing a similarly curved foundation plate and chill, the molten steel being run in between them.

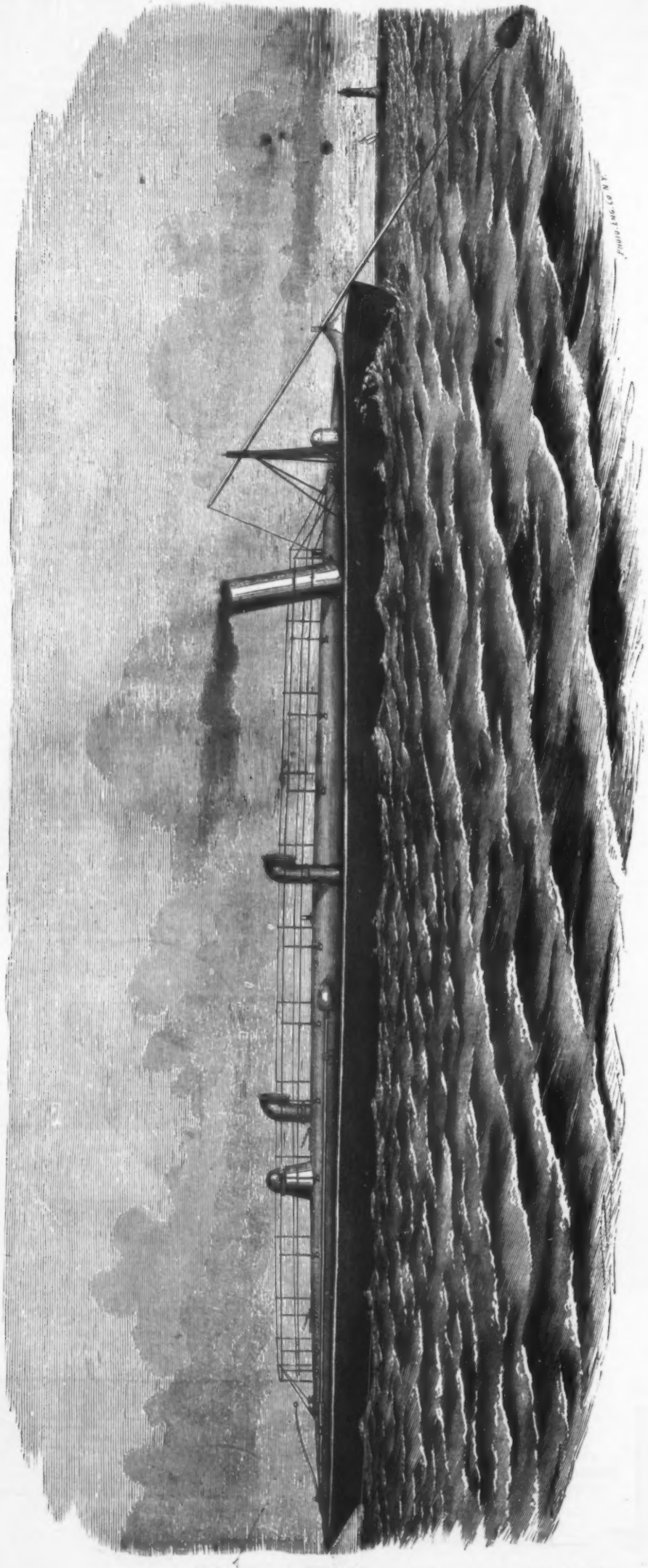
Sir Joseph Whitworth's plate is on quite a different principle. It consists of a solid shield of steel of softer nature, drilled with holes at intervals of a few inches apart, in which are screwed pins, or plugs, of harder steel of high quality. These are so closely distributed over the shield that a shot cannot strike it without coming in contact with some of them. The plate may benefit in two ways: first, the plugs are designed to break the projectile; second, they tend to prevent the extension of star cracks, on the same principle as a crack in a fire-box plate may be terminated by the insertion of a rivet-hole. We have recently seen a plate made on this principle at Sir J. Whitworth's which had been fired at, and which had stood well. The experiment, however, had been made on a smaller scale than that on which it will take place on board the Nettle, so that Mr. Wilson has the advantage in the matter of experience. Both competitors furnish their own bolts, made on the pattern submitted to them. Both, we may add, are employing steel for the material.—*Engineer.*

IMPROVED FAST TORPEDO BOATS.

Although torpedo boats, or launches as they are sometimes called, have hitherto played a comparatively insignificant part in naval warlike operations, the fact remains that they deserve to be ranked among the most remarkable structures ever made by engineers and shipbuilders. The modern torpedo boat is a small craft, capable of attaining a speed equaled by but a very few large steamships. Although exceedingly light, her machinery is able to work up to an excessive power as compared with its dimensions. The arrangements for the protection of the crew render the adoption of peculiar devices connected with the working of the boat essential; and the devising of proper mechanism for the purposes of offense has taxed the best powers of the electrician. A first-class torpedo boat presents, therefore, a combination of the work of the shipbuilder, the engineer, and the electrician, which is even now almost unique, and which could not possibly have occurred a few years since. A good deal in the way of description has been put before the world of late; but we believe it may be stated that very little indeed is known outside a limited circle concerning the construction or arrangement of these singular craft, and we venture to think that a description of the boat which we illustrate this week will be found not only to prove what we have just advanced, but that it will possess no small interest for our readers. Before proceeding further, however, we must state that the success of these boats depends on the adoption of certain proportions of parts which would not form the subject matter for a patent, although the information on which they are based has only been obtained by a few individuals by much patient inquiry, and after many experiments. Again, certain points of detail are regarded as



WILSON'S IMPROVED ARMOR PLATE FURNACE.



IMPROVED LIGHT DRAUGHT, FAST TORPEDO BOATS.—YARROW & CO., ENGINEERS, LONDON.

things to be kept secret by the warlike Powers for whom torpedo boats are built. The propriety of reserving information concerning these things will be recognized by our readers; and although we propose to tell them more concerning torpedo boats than has ever, perhaps, been told before, it must be understood that we do not profess to give information as to how a torpedo boat is to be built, or to explain what dimensions should be given to each part.

Our full-page cut illustrates a type of torpedo boat of which a considerable number have been built by Messrs. Yarrow & Co., of Poplar, London, and which have given great satisfaction to the purchasers. The particular boat we illustrate is one of two built for a foreign government. She is 75 ft. long, and has a beam of 10½ ft., while her draught of water is 3 ft. Her length, therefore, is little more than seven times her beam, a condition which renders the extraordinary speed which she has attained all the more remarkable. During a run of two hours she has done 17 knots, or, in round numbers, nearly twenty miles an hour, while boats similar in other respects, but of somewhat lighter scantling, have attained a speed of eighteen knots, or twenty-one miles an hour—an astonishing result when we consider the comparative shortness of the craft and her considerable immersion. The boat illustrated is, like all other torpedo launches, built of steel of the best attainable quality, no other metal existing which would possess the requisite strength, stiffness, and lightness. An examination of the plan will show that the hull is decked over from end to end with a curved rifle shield, the plates of which are sufficiently strong to set small-arms at defiance even at comparatively close quarters. Strictly speaking, there is no deck on which men can stand; a couple of wire life-lines are rigged at each side, and between these a space about 4 ft. wide forms a precarious kind of promenade. But it must be understood that when the boat is on duty no one courts destruction by putting his foot on deck.

An excellent idea of the general internal arrangement of the boat is supplied by the outline drawing above. From this it will be seen that she is divided into eight compartments by seven transverse bulkheads, the forward and after compartments being used for stores, the two central compartments being occupied by the machinery, while the steersman and the officer managing the torpedoes are placed in the compartment immediately aft the engines. The steersman's head projects above the deck, and is protected by an iron truncated cone, the top part of which is movable like the visor of a helmet; when it is lowered he sees his way through a series of slots made all round the circumference of the cone.

The mechanism of attack consists of three torpedo spars, which are made of steel in order that they may be strong enough to pierce torpedo nets put down for the protection of the ships likely to be attacked. The bow pole consists of a hollow steel tube 5 ins. in diameter and 40 ft. long. Under ordinary conditions this rests snugly on the top of the curved shield, but when going into action it is forced out and lowered by a small steam engine provided for the purpose, which hauls on it with ropes, and is under the control of the steersman; the engine also raises the pole up and hauls it in. When the pole is out to its fullest extent it projects 25 ft. from the bow, and the torpedo itself is 10 ft. below the surface of the water.

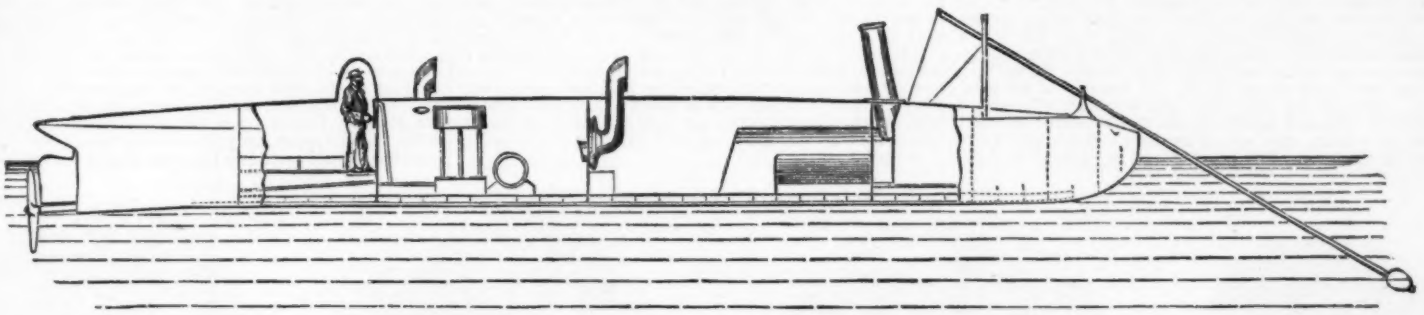
The bow pole is only applicable for attacking ships at rest, as it is found from actual experience that, in spite of its strength, it is quite unable to withstand the strain which would be brought on it by the resistance of the water when the launch is moving at seventeen or eighteen knots an hour. Besides, the presence of the torpedo in the water would materially diminish the speed of the boat, and interfere with her steering qualities, as may well be imagined. For what we may term a running fight, the torpedo boat is provided, as we have said, with two other poles, which are so fitted that they swing out from the side, as oars will turn in pin rowlocks. When using these, the boat endeavors to pass alongside the vessel which she is attacking, at a distance of 15 ft. or 20 ft. The end of a pole is then disengaged by the steersman. It drops overboard and is immediately swung round by the resistance of the water, and, if all goes well, comes into contact with the ship's side and explodes. Should the distance be too great, it falls astern, the pole lying alongside like an oar. It can then be recovered, and used for another attempt. The torpedo boat throughout the operation moves at full speed. It will be seen that the use of these torpedoes is extremely hazardous, unless the distance between the boat and the ship is carefully calculated. But considerations of this kind do not militate against the employment of a very ingenious expedient. So long as there is a chance of destroying an enemy's ship, brave men will not be lacking to try it at any personal risk.

The torpedo itself is a steel or copper case, holding 40 lbs. of dynamite, and is arranged to be exploded by an electric current, the current being closed either by the torpedo coming in contact with an obstruction, or at the will of the operator, on a system devised by Captain McEvoy. The torpedo is sometimes provided with a steel guard, which prevents it from being exploded by a net.

It need hardly be said that to devise machinery which should propel this boat at a tremendous speed, and which should at the same time work without noise or the escape of steam or smoke, was no light task. To secure the absence of smoke, Welsh coal is used; to prevent the noise of the exhaust and the escape of steam, condensing engines are employed. These are of the vertical type, compound, the cylinders being respectively 10 ins. and 18 ins. diameter, with a stroke of 12 ins. The framing is made of steel bars to secure lightness. The crank shaft makes 470 revolutions per minute when at full speed, the engines indicating 275 to 280 horse power. The piston speed is thus 940 ft. per minute, a velocity not often exceeded. It need hardly be said that extraordinary care is required in designing and constructing machinery of this kind. Not only is it essential that the moving parts should be balanced, but that they should be balanced in the right place and to the right amount. The bearings, again, require rather peculiar treatment. In fact, not only first-class material and workmanship but special experience are requisite to make engines for fast torpedo boats. The result in Messrs. Yarrow's case is quite satisfactory, as we know from personal experience that at full speed these engines will run for hours together without a hot bearing.

The steam is condensed by a surface condenser, standing athwartship, just in advance of the engines. The air pump, circulating pumps, and feed pump are worked by a separate vertical engine, running at a comparatively slow speed, so that they are certain in their action, which is by no means the case with pumps driven at a high velocity direct by the engines, while the chance of break-down is reduced should the engines race, through the propeller, which is two bladed and of steel, being exposed in a heavy sea. The boiler pressure is 120 lbs., and the vacuum is 24½ ins., a most excellent result under the circumstances. Steam is supplied by a boiler of the locomotive type, with an enormous grate surface. The funnel is fixed at one side of the line of the keel, to be out of the way of the torpedo pole, as will be seen by the plan. As the exhaust is not turned up the chimney, which is only 6 ft. or 8 ft. long, special arrangements have to be adopted to obtain a draught. For this purpose the boiler is placed in an air-tight compartment, access to which can only be obtained from the deck through an opening which is closed by a spring lid or cover. A fan is fitted on the bulkhead dividing the engine-room from the boiler-room, and draws air partly from the wind-cowl on deck and partly from the engine-room, which it thus serves to ventilate and cool. This fan is driven at 1,100 revolutions per minute by a small direct-acting engine, which runs without noise or heating, this being the highest velocity at which any engine has to our knowledge ever been run in regular work; and we need hardly say that the little machine is one which was not devised without some trouble, nor is it one quite like any other high-speed engine. The fan forces the air into the boiler-room in such volume that a pressure of about 5 ins. of water is maintained in it, which suffices to give intense combustion. Indeed, the coal can be burned at a greater rate per square foot per hour than in most locomotives.

Such, then, is the most recent and improved engine of naval warfare that science has given to the world. Nothing short of actual inspection, however, can give an adequate idea of the amount of ingenuity expended in overcoming difficulties and arriving at the required result. A trip on board such a craft, even for peaceful purposes, is sufficiently exciting. The sensation is very much like that which we fancy would be experienced by a man standing on the back of a "running" whale. When the screw is first caused to revolve the boat starts off at once at a quick pace, without any of that lingering to which most screw vessels are subject; but when, obstructions being passed, the way is clear, and the order to go at full speed is pronounced, the boat really seems to leap from beneath the feet of any one standing on the deck, if so it may be called, and the idea imparted is far more like that of traveling on the foot-plate of a locomotive than of steaming in a boat. We recently accompanied Mr. Yarrow on a trial trip made with the boat we illustrate from the Isle of Dogs to the measured mile at Greenhithe. No attempt was made to force the boat, the maximum pressure carried, and that but for a short time, being only 80 lbs. The wind was blowing hard down the river and the tide running up. The result was a very heavy sea for so small a boat—a sea which was heavy enough to sink a sailing barge. Only one run up was made on the measured miles, and the speed attained was 2 knots in seven minutes, or 17 knots per hour. This velocity was maintained nearly all the way back to Messrs. Yarrow's yard. The little craft took the head seas like a duck, or rather she parted them right and left, taking in no water forward, and only heavy spray at a point amidships. It would appear, therefore, that the launch is not only fast but a very good sea boat—a point to which considerable importance is attached.—*Engineer.*



LONGITUDINAL SECTION OF FAST TORPEDO BOAT.

THE DESTRUCTION OF SUBMARINE CABLES.

SUBMARINE CABLES are subject to numerous causes of deterioration. In the first place, on northern shores, there are the banks of floating icebergs, which sometimes extend to a depth of 500 or 600 meters. In their journey southward, these ground and break under water; the broken masses dislodge the cable which crosses their path. This kind of accident often occurs to the Atlantic cables on the coasts of Newfoundland.

Next to ice-banks must be mentioned wear and tear on rocky bottoms. Near the coast-line, says M. Ternant, in a treatise on the repairing of submarine cables, the depth may vary rapidly, so that the cable does not lie evenly on its bed; one end lying on a rock may have to bear the entire weight of the portion of the cable which is unsupported. A continuous to-and-fro movement, arising from the agitation of the sea or from ordinary tides or currents, determines the gradual wearing away, albeit slow, of the external wires. The sheathing once destroyed, the conducting wires yield and break, or the continued attrition of the core lays bare the conductor, making earth and stopping communication. The cable between Bonifacio and Sardinia was interrupted in 1861 from this cause; and the six conductors it contained were broken by the stretching inside the gutta-percha, which only yielded to the strain in picking up. We may further mention as causes of destruction, coral beds, earthquakes, submarine eruptions, and high temperature on tropical coasts.

The enemies in the animal kingdom are not less numerous. A curious observation was made after the laying of the cables on the Brazilian coast. As is known, Brazil was connected with Portugal in 1875. At the same time a series of cables round the coast completed the system from Pernambuco to Para, Cayenne, Demerara, and the Antilles. The observation referred to was made in the Para Cayenne section. It consisted of singular bites due to attacks made by the saw-fish, which abounds in those parts. A similar occurrence to the Singapore Cable in 1871 was described in *La Nature* in 1873 (Vol. I., p. 160). Mr. Buckland found among his collection a fish-jaw, from which he detached the saw; and with this he reproduced upon a piece of cable a fault similar to that which had caused the interruption.

In Brazil this kind of fault has become chronic; we gather our information from the engineers in charge of the laying. In the first piece which failed, one of the protecting iron wires was wrenched so as to expose the hemp with which the core was served. In the center of this part a piece of bone, apparently the scale of a fish-tooth, was found thrust through the hemp into the gutta-percha. On the same side of the cable, about two inches distant, another piece of bone was found in a similar position. Each of these scales was about one inch in length, and about one-eighth of an inch in diameter.

In another fault, one of the wires was bent inward, the remainder of the strand being slightly deformed and the "lay" taken out. One of the crew, during the heaving in, drew out from the cable a triangular splinter of enameled tooth, about a quarter of an inch thick; this piece was fixed between the wires. On stripping the core, a small puncture was discovered, as if made with a broach.

A third fault was of a more mysterious nature. The cable showed no appearance of being defective. When the external coverings were stripped off, and the core bared, a hole about the size of a pin's head was seen, filled with a whitish substance resembling glazier's putty. One wire of the internal sheathing was found severed exactly over this hole; the external iron wire which lay immediately over was bent into a crook about two inches off. A small portion of the exterior serving was displaced in the region of the fault. On cutting through the core close to the fault, so as to expose the conductor, more of this soft, crushed, pasty matter was found. Two small fragments of hard bony substance were found in the interior serving. These bites showed traces of decomposition; but they were so small that it was difficult to say if the foreign matter was bone or scale. The fragments were somewhat fibrous and semi-transparent: there is little doubt, having regard to other signs, that they came from a fish. The white substance was certainly decomposed dental matter.

These three faults were all found within 15 miles of each other, about 130 miles from Para. A fourth one was found in the deep-sea type; and although no fragments of teeth were discovered in it, the distortion of the sheathing wires showed that it was due to the same cause as the preceding. A fifth fault, picked up 270 miles from Para, half way to Cayenne, was not so evidently caused by fish, although such is just possible. The core in this case was pierced as before, but this time the hole was filled with a black substance; the copper gave signs of indentations like teeth marks. The teeth must have been very strong to have freed themselves. Mr. Warren has told how, after these faults had been taken out, the cable was again interrupted in the following year with five more fish bites at about the same place. From one of these a piece of hard bony substance, an inch and a half long, was taken, while the piece still fixed in the cable was an inch in circumference. Mr. Warren was much puzzled to know by what fish these attacks were made, until arriving at Demerara, where he identified the teeth of the saw-fish, which abounds in those waters and on all the northern coast of Brazil.

After the saw-fish, three insects may be mentioned whose misdeeds have been known some years, which were described by Mr. Preece before the Society of Telegraph Engineers.

The *Teredo* is a worm which constructs a shelter in the form of a tube by secreting calcareous matter. The *Xylophaga* is a bivalve. The latter does not penetrate far into the gutta-percha; it only fixes one valve into it. In small cores this is sufficient to produce a considerable loss of current.

The *Teredo* and the *Xylophaga* are found in the Mediterranean, in the Atlantic, and even in the northern seas.

The *Teredo norvegica* is a worm of considerable dimensions, and is armed with bivalves in the form of shells, which enable it to gnaw the hardest wood. It belongs to the class of acephalous mollusks; naturalists count at least twenty-four different species.

The *Limnoria lignorum*, called also *L. terebrans* by Dr. Carpenter, is a little crustacean of the size of an ant, so that it can get through the interstices of the sheathing wires even of the best made cable, and penetrate to the core, through which it burrows. In the Indian Ocean and the Persian Gulf, the *Limnoria* attains larger proportions, and effects excavations of considerable size. It is frequently met with on the shores of Ireland, where several cables have been seriously damaged by it.

HARVEY'S IMPROVED TORPEDOES.

Each torpedo consists of an external case of well-seasoned elm about 1½ in. in thickness, screwed together with water-tight packing between the joints and bound with iron, the interior being usually cemented with an unnecessary quantity of pitch. We do not quite see why so much care should be taken to render the outer case impervious to moisture, when all that is practically required of it is to protect the internal water-tight case for containing the explosive from injury; this inner case is constructed of stout sheet copper carefully soldered at the joints and provided with a cylindrical tube running through the center, into which is fitted the exploding bolt and priming charge; it has also two circular ports about 3⅛ ins. in diameter, one on either side of the bolt for charging the torpedo. These ports are rendered water-tight by means of screw caps forced firmly down on to suitable water-tight packing. The priming case is made of stout sheet copper, and contains a large bursting charge of rifle-grained powder or gun-cotton disks.

In the center of the priming chamber or cylinder is a brass tube in which the exploding bolt works, and at the bottom of this tube is a steel pointed anvil which, when the bolt is forced down, pierces the capsule, and striking the muzzle ignites the detonating compound, and through the bursting charge the main charge itself. At the side of the brass tube, and near the base of the pin, is a small hole covered with thin brass foil, which will allow of an escape of water into the priming case, should any have collected at the bottom of the tube. The priming case is charged from the bottom, on the same principle as the loading ports for the main charge, a powerful box spanner being employed for screwing in the caps. The priming chamber may be charged separate from this, if preferred, but this precaution is quite unnecessary, unless the explosive used be a dangerous one, in which case it would, of course, be impossible to be too careful. While the torpedo is in store, the steel anvil is buried in grease in order to protect it from corrosion. The torpedoes, in order to facilitate their use in every way possible, are made in two sizes, the dimensions of the external case being as follows:

		ft.	in.
Large torpedo	Length	5	0
	Breadth	0	6¼
	Depth	1	8¾
Small torpedo	Length	3	8
	Breadth	0	5
	Depth	1	6

The following is a scale of charges of different explosive compounds that, according to the statement of the inventor, Captain Harvey, the internal copper cases are capable of containing, providing the materials be carefully packed, calculated upon the basis of the larger case being of sufficient capacity to contain 77 lbs. of water, and the smaller one 28 lbs.:

	Large.	Small.
	lb.	lb.
Glyoxilin	47	16
Shultze's blasting powder	60	23
Compressed gun-cotton	60	22
Picric powder	73	26
Rifle-grained powder	76	27
Horsley's original	80	28
" blasting powder	85	30
Noble's dynamite	100	35
Litho-fracteur	90	33

Some of the powders named are scarcely suitable for submarine mining purposes for reasons that will follow in a later article.

Referring to our illustration, Fig. 1 affords a perspective view of the starboard torpedo, which differs from the port torpedo only in respect to the position of its inclined plane G. Fig. 2 represents a sectional view of the copper case for containing the explosive, constructed, as will be seen from the position of its inclined plane, to suit a port torpedo; A is the copper case, B the brass tube or priming chamber into which is fitted the exploding bolt, and C C the ports for admitting the explosive. Fig. 3 is an enlarged view of a starboard torpedo with slings adjusted ready for launching, the exploding bolt being shown in section; A is the wooden case, B B iron clamps, D priming chamber, E exploding bolt, F lanyard or side lever, G foretop lever, H after lever, I I loading ports. Fig. 4 is an enlarged sectional view of the exploding bolt; A is the priming case made of stout sheet copper for containing the bursting charge, B the brass tube in which the exploding bolt works, and C the steel pointed anvil or pin; this tube contains the detonating charge, and the tube A the bursting charge, the explosion being brought about by the action of the external levers appertaining to the torpedo forcing down the exploding bolt D. The exploding composition with which the bolt is charged is very powerful, and is only ignited by the bolt being forced down with sufficient force to drive the anvil or steel pin at the bottom of the tube through the capsule covering the extremity of the bolt.

With a view to avoiding accidental explosion, the bolt is made to work with a pressure of 40 lb. in the large torpedo and from 15 lb. to 20 lb. in the smaller one; this is effected by means of the metallic capsule with which the bolts are hermetically sealed to prevent moisture entering and destroying or deteriorating the composition with which the bolt is charged, and also by the quantity of thread wound round the spindle; this last, in addition to preventing the ingress of water, owing to the great proportional length of the stuffing box, allows of the very nice adjustment of the bolt to the weight required to overcome its resistance. The thread usually employed for packing purposes is of the kind known as whity-brown. As a further precaution, and in order to prevent the accidental explosion of a torpedo on contact with a friendly ship, a safety key is employed, passing horizontally through the spindle and resting on the brass muzzle of the priming case; this key is secured in its place by means of a few strands of whity-brown thread passed through an eye in the key and wound round the spindle, a small strong cord known as the safety key line serving to remove the safety key on the approach of the torpedo to an enemy's ship.

Fig. 5 illustrates the form of brake used for the purpose of controlling the tow-rope; these brakes, for the protection of the men, should, in a properly constructed vessel, be placed below the water-line, but in ordinary vessels may be secured to the deck by means of bolts or screws. It consists of a reel A resting on two standards B B, and provided with two drums C C, over which are passed the straps D D, one extremity of the straps being secured to the levers E E, in the manner shown. The surface of the drum in connection with the strap should be powdered with resin to increase the friction, and the tow-rope so ruled that in veering the reel may revolve toward the men at the levers; also, several tow-ropes should be coiled on the drum, that in the event of one being cut away another may be readily bent.

Fig. 6 is a small brake on the same principle, used to draw out the safety key when the vessel is traveling at a high rate of speed; when the vessel is going a slow speed it will not be necessary, as the safety key lines may be attended by hand.

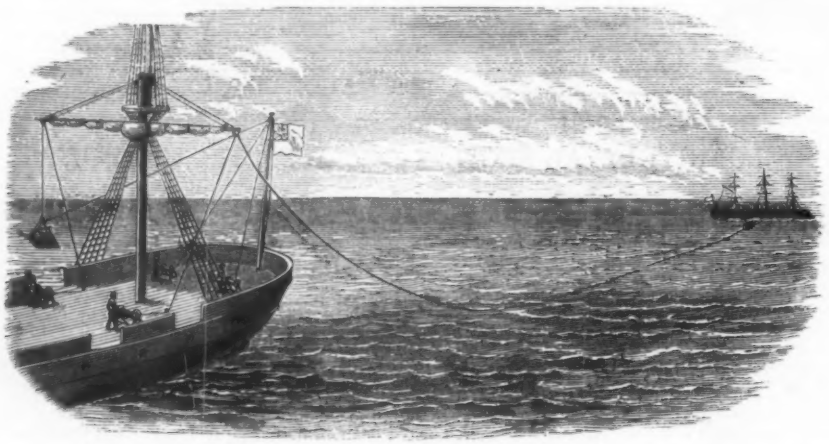
To connect up the torpedo for service a small strong line should be permanently secured to the short arm of the lanyard or side lever F; the end is then rove under the fair lead J, and up through the brass oval hole in the lever G, then down under the fair lead J once more, and across to the hand, when it is secured with a round turn and two half hitches, care being taken that the fair lead and the lanyard be set up sufficiently taut to give a slight spring to the after-top lever. The object in arranging the levers in this manner is obviously to insure either a top or side blow forcing down the exploding bolt, which being connected to the after-top lever, which in its turn is connected to the fore-top lever, may be driven home by either the fore-top, back-top, or lanyard lever. It is very important that the slings should be properly adjusted, as the divergence of the torpedo depends upon it. The after legs C^1 and C^2 of the slings, when stretched out alongside the torpedo, should extend one foot in front of the stern iron for the large torpedo, and eight inches for the small; the slings or ropes are all brought to one junction formed by a bell-mouthed thimble, which, when all four ropes are pulled out in the direction of the tow-rope, should come in a line with the upper towing irons, all the ropes bearing an equal strain. The slings should be made of the best Italian hemp, and of the same strength as the tow-rope, since, although the strain while towing may be divided, it may on collision be brought all on one.

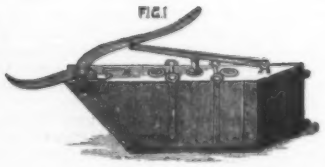
The dimensions of the tow-ropes for large and small torpedoes may be as follows:

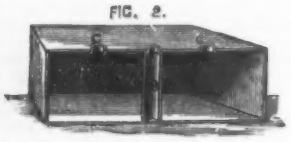
Large 3 in. hemp rope, or 1½ in. galvanized iron wire rope.
Small 2 in. " " 1 in. " "

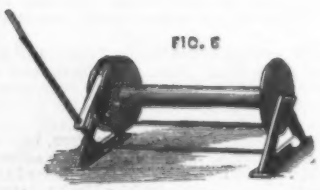
The buoys marked on the illustration L L, Fig. 3, are made of solid cork disks built up on a galvanized iron tube running longitudinally through them, wooden cones being used at either end to screw up and bind them fast together. The buoys employed in connection with the large torpedoes are about 4 ft. 6 in. long by 15 in. square in the center. Two buoys are used for each torpedo, the buoy rope being five or six fathoms in length, and of 2-in. hemp.

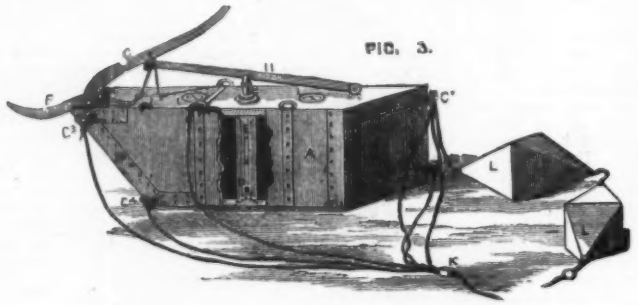
When the torpedo is launched out on its mission, very much of the probable success of that mission depends on the man in charge of the brake occasionally checking it, and not allowing it to dive, which it will do if checked too suddenly. Should it be necessary to cut adrift the torpedo in consequence of coming suddenly across a friendly vessel, the tow-rope should be cut close to the brake, when the torpedo will sink owing to the weight of its leaden keel. The torpedo may at any moment be made to dive by suddenly slackening the tow-rope, and by tightening it again bring it to the surface. The upper cut gives a general illustration of the torpedo in action.—*Engineering.*











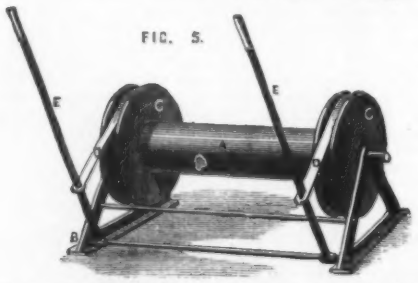


Fig. 4

The progress of the war between Russia and Turkey up to the present time shows that although the Turks have a formidable fleet of ironclads and other war vessels, the Russians by using torpedoes have overmatched their enemy.

TESTS OF CAR AXLES.

THE following is the report made at the last convention of the Master Car-Builders' Association, by Mr. W. E. Chamberlain, of the Boston and Albany Railroad. The figures which illustrate it are a little less than one-half the actual size:

For the last six or seven years some of the members of this Association have often discussed the cause of hot journals and broken axles, and at our rooms in New York for the last four years, at almost every monthly meeting, questions of every conceivable shape have been asked, but nothing definite determined upon. There are a great many causes for hot journals, and I am inclined to think, from past experiments, many of them cannot be detected by the naked eye.

Some six years ago I commenced a series of experiments with grease, plumbago, oils and brasses, and have often become puzzled at the results of the experiments.

The mode of operation in testing iron by etching is as follows: Cut the piece smooth on the end, and put it in an earthern dish, in which has been placed one-half chemically pure muriatic acid and one-half distilled soft water, enough of the acid and water being put in to make it about three-eighths of an inch deep; also throw in a little glass broken up fine, which will allow the acid to circulate freely under the iron; then let it stay in the acid two and one-half hours, after which take it out and print it, which is done by simply rubbing a roller saturated with printer's or lithographer's ink across the end that has been etched, placing a sheet of white paper over it, and putting it in a common letter press.

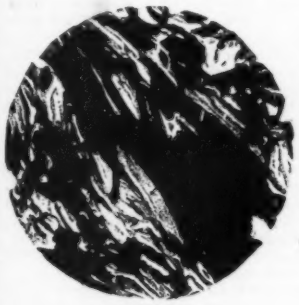


Fig. 2.

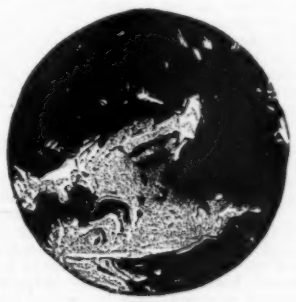


Fig. 3.

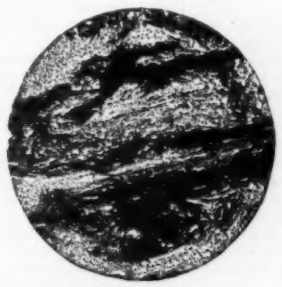


Fig. 4.

Fig. 5.

I find it is well to take an impression before etching, because if there are any imperfections in the iron they will show themselves. For instance, see cut No. 13.

The testing machine is nothing but a pair of scales of which a cut will be furnished at some future time. Cuts Nos. 1, 2, 3 and 4 were axles broken, and taken from under foreign cars. No. 1 broke off close to the inside of the hub of the wheel; No. 2 found broken off on the outside of the hub next to the box; No. 3 showed a defect 1¼ inch from the inside of the hub; we raised the axle on blocking so as the wheel would clear the track, and struck it, as hard as a man could strike with a twenty pound sledge, four blows, and the axle fell off. No. 4 was found broken off at the inside collar of journal; the size of journal on No. 4 was 6½×3½ ins. After etching I concluded it would be useless to try the tensile strength, but took the strength of the iron across the axle.

No. 1	broke at	35,270	lbs.	per square inch.
" 2	"	37,840	"	"
" 3	"	44,225	"	"
" 4	"	23,125	"	"

No. 5 was a line axle running between New York and Boston, and ran 250,000 miles. I do not attempt to give the quantity of oil used, because I expect to give it in some future report, when I shall have had time to more thoroughly prove my experiments, to know they are correct. Tensile strength of No. 5, 55,000 lbs. per square inch. No. 6 ran 50,000 miles and never ran cool, though repacked almost daily, until it became so hot I concluded to take it out. The color of the solid iron was a dark blue, while the light strips, or imperfect iron, were a light gray color, and projected slightly above the solid iron surface. Original size of journal, 3¼ ×5½ ins. There was considerable brass found in the box ground to a powder, and thoroughly mixed with the oil and waste; the waste looked as though it had been ground to powder in a mill, and formed a paste; under the microscope, it was found that the light strips, or imperfect iron, looked like knife blades, and projected beyond the dark surface, and at every revolution would grind out the brass, and pick up the waste and grind it between the journal and brass. The tensile strength of the axle crosswise was found to be 32,550 lbs. per square inch, it being useless to take the strength of the iron lengthwise.

No. 7 is one of four steel axles that ran 309,000 miles, and to my knowledge never ran hot, or even warm. The original size of journal when put in was 3¼×5½ ins., and when taken out was 3⅞×5¼ ins. The tensile strength was 68,360 lbs. per square inch, showing after the fracture a very tough fibrous metal, and under the microscope looked like a mountain of ice crystals clinging to one another.

No. 8, steel axle, ran 248,000 miles, and warmed up a number of times, although it was well lubricated. This journal was found to be worn egg-shape. Original size of journal, 3¼×5½ ins. I have no cut representing the egg-shaped journal, because the journal was good; it was being turned up when the discovery was made, and when we had turned it up to the shoulder we found a flaw, which, of course, condemned the axle. The tensile strength I took twice from two different places, but the variation was so great I cannot give it accurately.

No. 9, iron axle, ran 227,000 miles. Original size of journal, 3¼×5½ ins.; when taken out, 2 13/16×6⅝ ins.; tensile strength, 66,500 lbs. per square inch; very tenacious, with

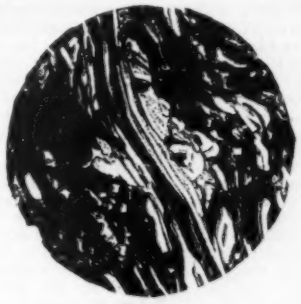


Fig. 1.

long fibers. No. 10, iron axle, ran 128,500 miles, when a flaw was found at *O* and *D*, both running almost the full length of journal, the fiber at *d* being loose, working backward and forward similar to No. 6, the tensile strength at *E* being 68,230 lbs. per square inch, and at *F* 35,200 lbs. The fibers at *E* were long and tenacious, and a nice silver gray color; at *F* the fiber looked like a lot of silver bricks, all points and nothing to hold them together. No. 11, steel axle, ran 97,000 miles. Original size of journal, 3¼×5½ ins.; when

Fig. 6.

taken out, 2 13/16×5⅞ ins.; often hot and roughed up, full of flaws and imperfections, and had to be smoothed several times. No. 12, iron axle, ran 192,475 miles; original size of journal, 3¼×5½ ins. Unfortunately the brass broke in the center, and spoiled the journal; size when taken out, 3 1/16 ins. at the ends and 2 15/16 ins. at the center; tensile strength, 68,120 lbs. per square inch. Very homogeneous; long fibers, which would cling tenaciously together. No. 13, iron axle; original size of journal, 3¼×5½ ins.; ran 50,370 miles, hot six times, no imperfections visible; tensile strength 68,422 lbs. per square inch; perfectly homogeneous; long fibers and very tenacious. When the axle was condemned and I had got the tensile strength, I was surprised to find the mileage so small, it being so homogeneous and tenacious. After etching it showed for itself, being made of the very best of material but poorly manufactured.

The experiments above are not altogether satisfactory to myself, because I did not know exactly how to accomplish what I wanted. It requires some little experience before a person can judge correctly the quality of the metal. I have found from experiments that because either steel or iron are homogeneous, it is no criterion that they are fit for car axles. I think they should be homogeneous iron well worked, and of a long fibrous nature, rather than a fine-grained iron; the elongation would show the difference in the tensile strength between the long fibrous and the fine-grained irons. At some future time these experiments will be reported with diagrams explaining each one more perfectly.

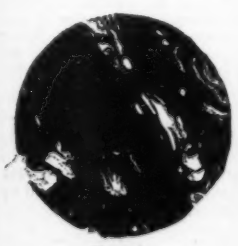


FIG. 7.

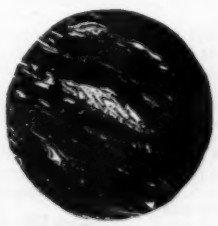


FIG. 8.

FIG. 9.

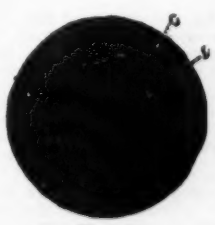


FIG. 10.

FIG. 11.

FIG. 12.

FIG. 13.

TAY RAILWAY BRIDGE.—The great Tay Bridge has now been formally taken over by the railway company. It is expected that General Hutchinson will shortly make the necessary inspection of the structure for the Board of Trade. The test will consist in passing six engines over the bridge at one time very slowly, stoppages being made as may be desired by the Inspector. The engines are in the course of construction. As soon as a certificate has been received from the Board of Trade the bridge will be used for goods traffic. The completion of the connections on the south and north sides of the river will be pushed forward with great energy, it being the desire of the company to have passenger trains running across in the course of April.

THE UNDERGROUND RAILWAYS OF LONDON.

THE following description of the admirable system of underground railways in London, which has already proved itself so convenient, safe, cheap and profitable, is from the English correspondence of the New York *Sun*:

A union depot of all railways having termini in London is impracticable. Neither law nor public sentiment would allow trains to run through the open streets, as is common in our American cities and towns. The necessity for some sort of easy communication between the various termini had long been sorely felt, and but two methods were possible—one by a subterranean and the other by an elevated railway. Though the task seemed almost superhuman, the former method was determined upon. The public received the plan as the offspring of crazed brains, and for a long time the shares of the new enterprise went begging for purchasers. As the prospect of the opening of the line increased, the shares reached higher prices, but it was not until after the actual opening of the road that they became favorite securities. The ordinary shares of the original company—the Metropolitan—are now quoted at 116, and preferred shares at 136. From the very day of its opening the Underground Railway was a triumphant success in every particular.

In the construction of the road many difficulties were encountered. Underground London is a network of gas and water pipes and sewers, and it needed almost the skill of a surgeon to avoid them or to turn them into new courses. Three times they had to tunnel their way under the great sewer main known as the "Fleet Ditch," and the passage of the sewage could not be interrupted for a moment. At one point near Farringdon street station the tunnel is fifty feet below the surface of the ground, and at other points the top of the tunnel is but two feet below the surface. Where its course lay under blocks of buildings, the company were obliged to purchase both land and buildings, and the latter were generally demolished. The cost seems almost fabulous. For the total length of about eight miles the outlay was $40,880,000. This is the part which belongs to the Metropolitan Company, but it is not the whole of the Underground Railway. Yet on this vast capital they manage to pay over 4 per cent interest in the shape of dividends. That is fair interest in England, though not as much as a number of other roads pay. The original line was opened for traffic on January 10th, 1863.

The lower half of the Underground Railway, or the part nearest the river, is owned by an entirely distinct company, and was opened for traffic to its present terminus on July 3d, 1871. This part is known as the District Railway. The two lines work in unison, however, and the entire circuit is made without change.

The railway makes nearly a complete circuit of the heart of that part of London which lies on the north side of the Thames. Beginning toward the eastern part, near the Tower, it passes north of the Bank of England and within five minutes' walk of it; passes near all the great railway termini in the north of the metropolis, and to the west of Hyde Park and Kensington Gardens, at a point about six miles west of the Tower, bends southward, and then eastward, touching the river close to the Houses of Parliament and Westminster Abbey. Thence it follows along under the Thames embankment, close to several other great railway

termini, and finally halts again near the Bank of England. The terminus near the Tower is Aldgate station, and the other the Mansion House station, and the distance between the two is about a mile. A company has been organized for the completion of the circle, and, when completed, trains will not, as now, be compelled to switch and return on the other track upon reaching the terminal stations. West of Kensington Gardens the road divides, and a kind of loop is formed, running about a mile without the inner or main line. This loop is about 4¼ miles long, and in connection with the main line forms a sort of outer circle. Trains make the entire circuit on both the inner and outer circles. The main circle is about twelve miles long, and has 24 stations. The whole line has a double track, and the tunnel is a single span or arch of brick. There are 8 rings of bricks, and so solidly have they been put together, that, so far as I have been able to ascertain, there has not been found a single settlement of the brick work in the whole line.

When the road was projected, it was thought that its freight traffic would be its principal source of income; but that was a great mistake. Its freight traffic is quite insignificant, but its passenger traffic is enormous. Other lines have found it very convenient to utilize the rails of the Underground Railway, as a means of running their main line trains nearer the business part of London. Every great railway terminus in London is in almost immediate proximity to some part of the Underground Railway. The carriages used are the same as on other British railways, and the usual first, second, and third classes are run on all trains. As the ordinary system of railway signals would not answer their purpose, they use a special system of their own. All carriages are lighted with gas, and by an ingenious plan a supply is carried on each train.

Trains begin running about 6 o'clock in the morning, and are entirely discontinued about midnight. Each week-day 220 up-trains depart from the Mansion House station, and about the same number of down-trains also leave Aldgate station daily. During a large part of the day, fourteen trains depart hourly from each terminus, or at intervals of only a little more than four minutes. As on most other British railways, tickets are available only on the day of issue. Each train stops at all stations, and the time of making the trip on the inner circle is an hour and three or four minutes. At some stations, when there are but few passengers to get on or off, less than fifteen seconds sometimes elapse from the time the train stops until it is again in motion. The usual stop at stations is about 25 seconds. About eight carriages usually accompany each train, and fully half of these are for third-class passengers. In 1875, third-class passengers formed 66 per cent of the whole number, second-class 20 per cent, and first-class nearly 14 per cent. In 1863, the first year of the road, the Metropolitan Railway carried 9,455,175 passengers; in 1866, the number was over 31,000,000, and in 1875 over 48,300,000. The section owned by the District Company is not included in this estimate. In the last-mentioned year the District Company carried nearly 26,000,000 passengers. That gives an average of over 203,000 persons daily traveling upon the Underground Railway in that year. On Whit Monday of the same year (a public holiday), 246,577 persons traveled on the Metropolitan line alone, and on Whit Monday of 1877 the number was a few thousands greater than in 1875.

It will be seen that this road, which the public sneered at while it was building, and spoke of as a "great sewer" and a "hopeless speculation," has become very useful; indeed, it is difficult to see how London could now get along without it. Including the loop of the outer circle at the West End, the length of the whole road is about seventeen miles, of which each company owns about half. The traffic of the Metropolitan Company, however, is much the greater, and its financial management is also much better.

Fares are very reasonable. On the District line the fares for a single station are generally 4, 3, and 2 cents, for first, second, and third classes respectively; and return tickets, 6, 5, and 4 cents. For very short distances the Metropolitan charges a trifle more. Here a single station is 6, 4, and 2 cents, and for return tickets, 8, 6, and 4 cents. The Underground Railway is forced to compete with the cheap and omnipresent omnibus; and hence, when the distance is as much as a mile, the fare for third class must not be above two cents a mile. To the extreme point on the line—six miles—the third class fare is but 12 cents. An omnibus will carry an equal distance for the same money. The railway, however, has the advantage in point of time. First-class fares are about double the third-class rates. For cheap, convenient means of travel, London may safely challenge the whole world.

The company organized to complete the circuit of the Underground Railway has its books now open for subscriptions. This will be the most expensive part of the whole line. The distance is a small fraction more than a mile, and the estimated cost is $13,250,000.

PROGRESS OF THE GREAT NEW BRIDGE OVER THE HUDSON RIVER AT POUGHKEEPSIE.

WORK on the proposed great bridge across the Hudson river at Poughkeepsie is being prosecuted by the American Bridge Company of Chicago, under a contract with the Poughkeepsie Bridge Company to build the structure for a lump sum, the amount of which they decline to make public. Estimates of the cost of the work vary from $4,000,000 to $5,500,000. The original charter authorizing the construction of the bridge was granted May 10, 1871, and was for a "suspension bridge to be used for the passage of railroad trains, vehicles, cattle, etc." This charter required the work to be begun before July 1, 1872, and the bridge to be completed and open for use before Jan. 1, 1876. In 1872 the charter was amended, permitting the erection of shore piers on the dock line at each side of the river, and four piers in the river channel, at a distance apart of not less than five hundred feet, the piers to be kept lighted at night during the season of navigation, and a tug to be kept ready by the bridge company to assist tows in their passage. The time for beginning work was extended to Jan. 1, 1874, and for its completion till Jan. 1, 1879. The corner-stone for one pier on the east side was laid in December, 1873.

The capital stock was fixed at $2,000,000, with the right to increase it to $5,000,000, and with authority to borrow money to an amount not exceeding the capital. The act of incorporation requires the company to construct a bridge that shall serve for highway as well as for railway travel. Nothing in the supplementary legislation relieves them from this obligation, yet the company have contracted for a double track railway bridge only. The bridge is to consist of five spans, each 535 feet long, made entirely of wrought iron, and built on the rectangular truss plan. It will be of the kind known as a "deck bridge," which means that the trains run over its top instead of between the sides, as is usual. The bottom chord will be 135 feet above the water, and the side truss will be 65 feet high, making the railroad track 200 feet above the water. The longest truss bridge span heretofore built is 515 feet in length. The approaches are to be of iron spans and trestles, with a total length of 2,024 feet, and from 40 to 90 feet high. That on the eastern side will run over a thickly-built portion of the town.

The end or shore piers will be built about thirty feet back from the river edge. There are to be four piers in the river channel. At Pier No. 1, on the west side of the river, the masonry is now built to a hight of eighteen feet above the surface of the water. This pier was constructed in the following manner: First, a wooden caisson was built on the shore on ways specially prepared for it, very much like the ways on which ships are built. The caisson is fifty feet wide, one hundred feet long, and eighty feet high. It is made of yellow pine and hemlock sticks twelve inches square, three of which are laid side by side to form the outside walls; then crosswise and lengthwise, every ten or twelve feet apart, run partitions built in the same manner. These cut the caisson up into forty compartments. The bottom edge of the ends and sides of the caisson are built of solid timber, running from a cutting edge at the bottom to a thickness of twelve feet at a height of sixteen feet above the bottom, the outsides being perpendicular and the inside wedge-shaped. Lengthwise through the center runs a wedged-section of solid timber resting upon a sharp edge, and which is sixteen feet high and fourteen feet broad at its top. All of the bottom edges are shod with iron, and the timbers are framed and bolted together very securely; under each cross partition is a heavy iron draw bolt.

The cross partitions commence about six feet above the sides. Of the forty compartments formed in the caisson twelve only run through it from top to bottom; these are the chambers through which the mud is dredged from under the caisson. The remaining twenty-eight chambers run down to the top of the wedge-shaped outside and center sections of solid timber, and are pockets into which the concrete needed to sink the caisson into the mud is put. The twelve dredging chambers are twelve feet square throughout their whole length, except at the bottom, where they flare out by reason of the wedge-shaped sides and center piece. Viewed from the bottom they look like the chimneys seen in old Dutch farmhouses, or like enormous inverted grist mill hoppers.

This unwieldy mass, drawing nearly sixty feet of water, was towed into place in May, 1877, and concrete, composed of five parts of sand, stone and gravel to one part cement, was mixed on the deck of a scow moored beside it and lowered into the pockets or timber bottomed compartments by means of a clam-shaped dredger. This process continued as long as the caisson continued to sink through the mud, which at this point is forty feet deep. When the caisson stopped sinking the dredger was used to remove the mud from under it through the twelve dredging chambers, the wedge-shaped outsides thrusting the mud inward toward the center of the dredging chambers, while the center wedge thrust it outward in the same manner.

At each lift of the dredge five cubic yards of mud and clay were removed. This method was pursued until the caisson reached hard bottom. The clay and mud was at times so hard that the dredges cut several feet below the bottom edges of the caisson before it was forced down by the weight of the concrete in the pockets. Sometimes the mud was softer at one point than another, and the caisson sank unevenly. On the top of the caisson was built a coffer dam twenty feet high. The dredging chambers were then filled up with concrete in the same manner as were the pockets. This made twelve columns of concrete, each twelve feet square and eighty feet high, which rest upon a bed of concrete, fifty by one hundred feet, which, in its turn, rests upon the hard bottom of the river. There are also twenty-eight other columns of concrete that rest on the wedge-shaped timber bottom of the caisson. All these masses of concrete are bound together with cross walls of timber every ten or twelve feet each way. The water was then pumped out of the coffer dam and the masonry started at a depth of twenty feet below high water.

The masonry for the pier is seventy-four feet long by twenty-eight feet wide at base, and when completed will be thirty-six feet long by twelve feet wide at top, and one hundred and fifty-five feet high.

At the present time there are seventy men constantly employed at the work on this pier. Five steam engines are also in continuous use. All masonry above water is of cut granite. The Portland cement used in the work was manufactured by Mr. W. G. Coolidge, the engineer under whose plans and supervision the work is carried on.

The elevations at Pier No. 1, from the bed of the river to the railroad track, are as follows: Concrete, 80 feet; masonry, 155 feet; and bridge, 65 feet; making a total height of track above the river bed of 300 feet. At the other piers the distances will be somewhat greater. The depth of water at this point is 60 feet, and the width of river 2,500 feet. The bluff on the western shore is 135 feet high, and that on the eastern shore is 110 feet above the surface of the water.

The caisson for Pier No. 1 had been submerged into place by June 20. That for Pier No. 2 is already down 95 feet. The caisson for Pier No. 3 is partly completed, and stands upon the ways. No masonry has been built except at Pier No. 1. Under the present charter the whole work must be completed in one year from this date.

It is claimed by the projectors of the bridge that the Hudson river cuts off all New England and a portion of New York from "all rail" communication with the coal fields of Pennsylvania and the Great West. There are only two crossing places over it—the first at Jersey City, by ferries, and the second at Albany, by railroad bridge. For the 150 miles between these points there is no line of travel across the river. The projectors say that the section lying east of the Hudson contains one-sixth of the whole population of the United States and controls one-half of its manufacturing interests, and that to supply this section with coal and Western products without the expense of ferriage and additional handling, as well as the waste that arises from it, or the long line of expensive travel around by Albany, has always been a serious problem.

They also argue that all coal from Scranton (the coal center) which goes to New England must now be sent over one hundred miles out of its way, via Albany, or be carried by rail to some point on the Hudson, and thence by boat up the coast, to be again carried inland by rail for consumption.

New York city gets its coal largely from the Delaware and Hudson Canal, which route is frozen up nine months in the year. Large quantities are also ferried across from the railroads terminating at Jersey City, with a large loss from the waste in handling, as well as the cost of transhipment. It is claimed that when the bridge is done coal can be loaded at all the great mines and unloaded at Thirtieth street without intermediate handling; that all freight brought down the Erie Railway intended for consumption in New York city has only to leave the main line at Pine Bush and pass over the (to be built) eighteen miles of railroad track to this bridge, thence into New York without breaking bulk. The same is true of all freight that comes down the New York and Oswego Midland Railway. It is also set forth that Poughkeepsie is just half way between New York and Albany, and in a direct line between Scranton and Boston. A railroad eight miles in length will connect the bridge with the Wallkill branch of the Erie Railway. The railway connections on the east side of the river are now almost completed.—*N. Y. Sun.*

NEW UNITED STATES GOVERNMENT RULES IN RESPECT TO BOILERS, BOILER INSPECTION, STAMPING AND TESTING OF BOILER PLATES, FIRE APPARATUS, BOAT LOWERING DEVICES, AND LIFE PRESERVERS.

Circular to Supervising and Local Inspectors of Steam-Vessels, Boiler-plate Manufacturers, Boiler-makers and others.

JAMES A. DUMONT, Supervising Inspector General, under the authority of the Treasury Department, gives notice under date of February 1, 1878, as follows:—

Rules 3, 4, 8, 10, and 22, of Rules and Regulations of 1877, having been amended by the Board of Supervising Inspectors at their annual meeting, held in this city in January of the present year, and said amended rules having been approved by the Secretary of the Treasury, January 31, are published herein for the benefit of officers of the Service and others, who will, from and after this date, substitute these amended rules for those of the same numbers in the published Rules and Regulations of 1877.

The list of life-saving and other appliances attached hereto, having also received the approval of the Secretary of the Treasury, may also be allowed to be used on board steam-vessels, in addition to those already in use.

RULE 3. Every iron or steel plate intended for the construction of boilers to be used on steam-vessels shall be stamped by the manufacturer in the following manner, viz.: At the diagonal corners, at a distance of about four inches from the edges, and also at or near the center, of the plate, with the name of the manufacturer, the place where manufactured, and the number of pounds tensile strain it will bear to the sectional square inch.

When a sheet of boiler-iron is found by the Inspector with one or more stamps upon the same, the Inspectors shall in every such case be governed and rate the tensile strain of iron in accordance with the lowest stamp found upon the same.

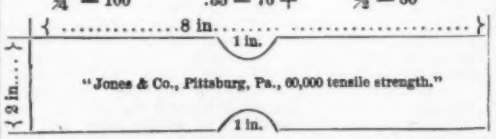
RULE 4. The manner of inspecting and testing boiler-plates, intended to be used in the construction of marine boilers, by the United States Inspectors, shall be as follows, viz.:

The Inspector shall visit places where marine boilers are being constructed, as often as possible, for the purpose of ascertaining and making a record of the stamps upon the material, its thickness, and other qualities. To ascertain the tensile strain of the plates the Inspector shall cause two pieces to be taken from each sheet to be tested, the area of one of which shall equal one-quarter of one square inch, the area of the other shall equal the square of its thickness, and the force at which these pieces can be parted in the direction of the fiber or grain, represented in pounds avoirdupois—the former multiplied by four, the latter in proportion to the ratio of its area—that piece showing the greater tensile strain shall be held to be the tensile strength of the plate from which the test-pieces were taken, and should the tensile strength ascertained by the test equal that marked on the plates from which the test-pieces were taken; the said plates must be allowed to be used in the construction of marine boilers; provided always that the said plates possess the other qualities required by law, viz., homogeneousness, toughness, and ability to withstand the effect of repeated heating and cooling; but should these tests prove the marks on the said plates to be overstamped, the lots from which the test-plates were taken must be rejected as failing to have the strength stamped thereon. But nothing herein shall be so construed as to prevent the manufacturers from restamping such iron at the lowest tensile strain indicated by the samples, provided such restamping is done previous to the use of the plates in the manufacture of marine boilers.

In the following table will be found the widths—*expressed in hundredths of an inch*—that will equal one-quarter of one square inch of section of the various thicknesses of boiler plates. The signs + (plus) and — (minus) indicate that the numbers against which these signs are placed are a trifle *more* or *less*, but will not, in any instance, exceed one-thousandth of an inch.

The gauge to be employed by inspectors and others to determine the thickness of boiler-plates, and the widths in the table, will be the *Darling, Brown & Sharp's* gauge, of Providence, Rhode Island, and will be furnished by the Treasury Department. This gauge has been approved by the Board of Supervising Inspectors:

.21" — 119 —	.29 — 86 —	5/8" — 67 +
.23 — 109 +	1/16" — 80	9/16" — 57 —
1/4" — 100	.33 — 76 +	1/2" — 50



All samples intended to be tested on the Riehlé testing-machine must be prepared in form, according to the above diagram, viz., eight inches in length, two inches in width, cut out at their centers in the manner indicated. Two small center punch-marks must be made on samples, one inch each side of their center, for the purpose of ascertaining their elongation or ductility.

In commencing a test, the person conducting the same must first apply weights to within four thousand pounds of one-quarter of the tensile strength marked upon the sample, and, after pumping the machine to equilibrium, apply the remaining weights, at intervals of about fifteen seconds, until the sample is parted.

The smaller weights must be applied last, and should a sample part immediately on the application of such a weight, the weight last applied must be rejected.

The machine must be kept at equilibrium during the application of the weights, and, after the first application is

made, the point where elongation commences must be ascertained by applying a pair of dividers to the center punch-marks, at every additional weight, until the test is completed.

All tests made of boiler material must be recorded upon a table showing the following:—

Date when tests were made.

From whom samples were obtained, and by whom tested.

Material, iron or steel.

Stamp or label on samples, which must be the same as stamps on the material from which they are taken.

Thickness of samples, expressed in hundredths of an inch.

Width of samples, expressed in hundredths of an inch.

Strain at which each sample parted.

Strain per square inch of section.

Elongation of samples, expressed in hundredths of an inch.

Time consumed in tests, expressed in minutes and seconds.

Weight on machine at which elongation commenced.

RULE 8. Inspectors shall not allow the use of vertical tubular boilers, on waters flowing into the Gulf of Mexico, unless the water-line of the boiler is the lawful distance above the upper end of tubes and fire-line.

RULE 10. All steamers hereafter constructed, navigating the ocean, sounds, lakes, bays, and rivers, and subject to the jurisdiction of the board, shall have a clear space of not less than sixteen inches on all sides of the boilers, and at the back end of all such boilers there shall be a clear space of two feet. Slip-joints in steam-pipes shall, in their working parts, when the steamer is to be employed in navigating salt water, be made of copper or composition.

All boilers hereafter built shall have a plate or plates of sufficient size fastened on the boiler on which shall be the name of the manufacturer, the place where manufactured, and the tensile strength of the iron, and also the name of the builder of the boiler, where built, and the year.

RULE 22. The main pipes and their branches required by law on steamers to convey steam from the boilers to the hold and separate compartments of the same—except the cabins—shall not be less than one and one-half inch in diameter, except on steamers employed on western rivers, which steamers may use branch pipes not less than three quarters of one inch in diameter. All branch pipes leading into the several compartments of the hold of the vessels shall be supplied with valves, the handles marked so as to indicate the compartments or parts of the vessel to which they lead. These valves or their handles shall be placed in the most accessible part of the main deck of the vessel, and so arranged, when practicable, that all can be encased in a box or casing, the door of which shall be plainly marked with the words "Steam Fire-Apparatus."

Mills' Auxiliary Steam-Generator. (Approved for use on boilers using fresh water.)

Heerman & Smith's Water-Back Heater.

W. W. Martin's Feed-Water Heater.

Herreshoff's Patent Safety-Coil Boilers. (Limited in construction to pipe of four inches in diameter.)

Farris' Water-Circulating Grate-Bars, and Water-Fronts.

Gerard's Electro-Magnetic Fire and Water Detector.

T. Flagler's Fire-Extinguisher.

White & Hays' Life Cork Jacket.

Geo. Clark, Jr.'s, Life-Preserver.

Kahnwieler's Improved Granulated-Cork Life-Preserver.

Connelly's Fire-Extinguisher.

Martin's Fire-Extinguisher.

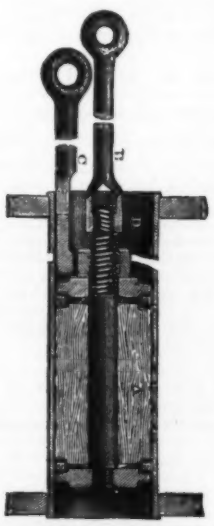
Geo. Judson's Life-Boat.

Torrey's Gondola Life-Raft.

Burke, Wise & Co.'s Life-Boat Lowering and Launching Apparatus.

IMPROVED TUBE-STOPPER.

WE illustrate a tube-stopper invented by Mr. Fenenga and made by Alley & Macclellan, Glasgow, Scotland. This plug consists of a central wooden piece A, having a screwed bolt through its center, provided with two iron washers. Two India-rubber rings E are clasped between the wood center A and the washers. When the nut is turned home



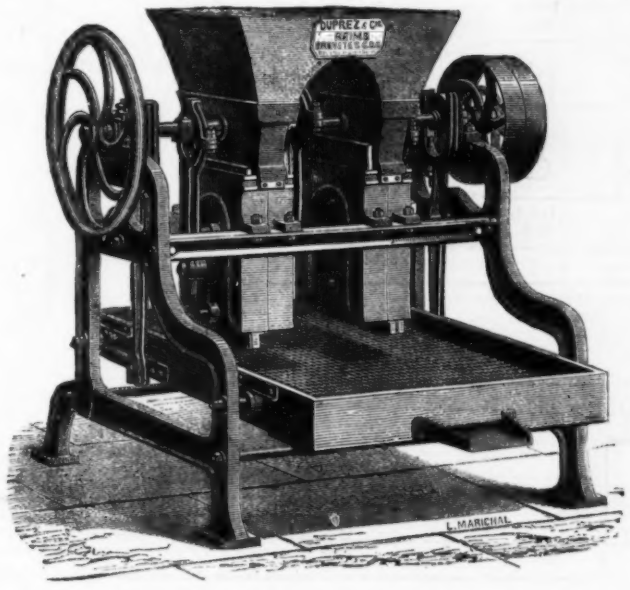
IMPROVED TUBE STOPPER.

by the spanner C, the rings E are forced outward against the tube D, thus forming a water and steam tight joint, which in practice is found to last for a long time. If the rubber is burned away, the wood center A has swollen by the action of the water, and made a joint that will stand with safety for any length of time. When the plug is inserted, the spanner C and holder B are withdrawn. In cases where there is more than one hole in a tube at a distance apart, a plug should be put in the back and a second in the front end of the tube. A leak can be stopped in a few minutes without, it is said, the slightest risk of scalding the workman.

At first sight it would be supposed that this plug, being only held in place by the friction of the two India-rubber rings, would be readily forced out should a pressure of steam be brought to bear upon it. For example, if two plugs were inserted in one tube, with the leak between them, a pressure equal to that in the boiler would soon be established. To settle this point, the makers carried out some experiments, with the astonishing result that one of the plugs 3 ins. in diameter withstood 260 lbs. on the square inch, hydraulic pressure, without moving. This being the case, the plug appears to us to be the best and simplest thing of the kind yet made.—*Engineer.*

MALT CLEANING MACHINE.

ONE of the mechanical problems involved in the very unmechanical art of brewing is the cleansing of malt previous to mashing. To effect this, M. C. Duprez, of Rheims, France, has designed the contrivance which we illustrate, and which has obtained the honor of a silver medal at a late exhibition in that city. The malt, rough from the kiln, is



IMPROVED MALT CLEANING MACHINE.

thrown into the hopper, whence it falls into a shoot fitted with a double set of stiff brushes, about one-eighth of an inch apart, and working against one another with a vertical reciprocating motion. While passing between the brushes the malt is thoroughly brushed, and completely separated from the germs. It then falls into a large double sieve beneath, driven by a belt from the axle carrying the eccentrics by which the brushes are worked, being there thoroughly screened and delivered by a shoot at the end. The brushes are very durable, and it is stated that three years' use does not impair their working. The machine appears to be extensively used in France.—*Iron.*

THE CALIFORNIA PETROLEUM INDUSTRY.

THE *Alta California* says: "After working under adverse circumstances for ten years, the petroleum miners in California are beginning to feel confident that their business is about to become profitable and prominent. The latest borings in the San Francisco District indicate the existence of a large body of oil, and, as in Pennsylvania, the best flow is obtained from the deepest wells. That district has now five productive wells. No. 1, when 180 feet deep, yielded twelve barrels a day, and now, having reached a depth of 400 feet, gives forty barrels. Well No. 2, when 165 feet deep, supplied twelve barrels, and at 380 feet threw up for a time forty-five barrels, but fell to thirty, at which figure it now keeps up. Well No. 3 is only 100 feet deep, and its pump, which brought up eight barrels for a time, now brings up only four or five. Well No. 4, when 260 feet deep, gave twenty-one barrels, and when it reached 480 feet threw fifty barrels to a height of sixty feet above the surface. Well No. 5 is 225 feet deep, and yields five barrels by pumping. The present yield is 120 barrels from three flowing wells, and ten barrels a day from two pumping wells. The crude oil contains 74 per cent. of kerosene and 8 per cent. of lubricating oil—the last superior to that of Pennsylvania because it contains no paraffine. The only other productive petroleum district in the State is at the Mission of San Buenaventura, where five pumping wells turn out twenty barrels a day. In the Ventura and Sulphur Mountain districts borings are in progress. In the Sespe District, also in Ventura County, no work is being done at present so far as we can learn. In the Santa Barbara District three wells are being sunk; in San Luis Obispo, one; and in the Moody District, Santa Clara County, seventeen miles southwest from San Jose, one. The San Francisco Petroleum Company has taken the lead in the most successful workings. The annual exportation of Pennsylvania kerosene amounts to 250,000,000 gallons, valued at $55,000,000, and after allowing for home consumption the yield of oil in that State may be said to be worth as much as that of the silver and gold of Nevada and California together. If now we could find in our State oil wells equal to those of Pennsylvania, they would not be trifles in the industry of our slope.

"A good deal of excitement has been shown recently about the new discoveries of oil veins in the Santa Maria Valley, in the northwestern portion of Kern County, California. An examination has been had by experts, who pronounce the supply practically inexhaustible, and the tests made of the equality of the oil are convincing of a very superior quality; several lamps in the town have been kept in use burning the oil just as it comes from the veins. It is the same oil belt now creating so much attention in Santa Barbara and Ventura counties. Locations have been made by parties residing in San Francisco, Sacramento, Stockton, and Visalia; and, through the examinations of the engineer, J. G. Parke, a number of citizens of capital in Kern County have secured the best of the lands. Two companies have already been organized, the Santa Maria, which is now negotiating for the necessary machinery for boring, and which expects to have everything on the ground ready to commence work by the first of February, and the Coast Range Petroleum Company, which was incorporated with a capital stock of $100,000. The lands are in the immediate vicinity of the Buena Vista Oil Company wells, which were long ago pronounced by experts as very valuable—the owners refusing $250,000 for their claims. At that time the difficulty of transportation by land was a formidable obstacle to the development. Oil became depressed in price from over-production at the East, and the claims were neglected."

THE OIL PRODUCERS' CONVENTION.

WITH reference to the work of this convention, which recently met at Titusville, the *Herald*, of that place, says: "In respect to the organization, statistics, legislation, transportation, control of stocks, etc., the council have arrived at very positive ideas and resolutions. Not the least of these undertakings, and promising abundant success, is a pipe line from the Allegheny river to Baltimore and the seaboard. It is understood that the line will cost $2,000,000 to build; that it will take six months to do it; that the cost of drilling operations of a single month will defray the expense; and with the right of way already secured, and with protection of the sale and transfer of the line, it is believed the key of the situation is in the possession of the producers. Oil can be carried through this pipe line to the seaboard for fifty cents a barrel. This, it is believed, will enhance the price of crude oil at the wells, and may cause refining to be done at the seaboard or abroad. Such is the plan, or a part of the grand scheme, which the council are inclined to favor and adopt, and which is to be matured and perfected hereafter." The Council of Oil Producers is said to represent $75,000,000 in oil lands and machinery, and to own three-fifths of the entire tankage of the region.

NEW OIL DISCOVERIES IN PENNSYLVANIA.—A singular circumstance is reported from the Holder Run oil section, in the shape of the striking of a deposit of oil by H. L. Westerman & Co., which exhibits none of the impurities of petroleum when it comes from the ground, but, on the contrary, spouts from the sand in a refined condition. The oil comes from the well a pale green transparent fluid, and can be used in lamps at once. It gives a brilliant light, with no smoke or odor, and stands a fire test of 110°, a lighted match being thrown into a vessel containing the oil failing to ignite it. It deposits very little sediment.

AN OIL WELL, producing over 600 barrels a day, and said to be "the biggest well in the oil region," was struck at Karns City recently. It was an old well that had been pumping for nearly five years from the third sand, producing when struck, in January, 1873, 250 barrels a day, and having produced over 50,000 barrels of oil since that time. The well was producing very little, and the owner concluded to drill it to the fourth sand to test it, and the yield above stated was the result.

OIL has been found in the Cowanesque Valley, near Elkland, Tioga County, and also at Mansfield, Alleghany County, Pa.

The Smith's Ferry oil region, on the Ohio river, below Pittsburg, is producing about 600 barrels of oil a day.

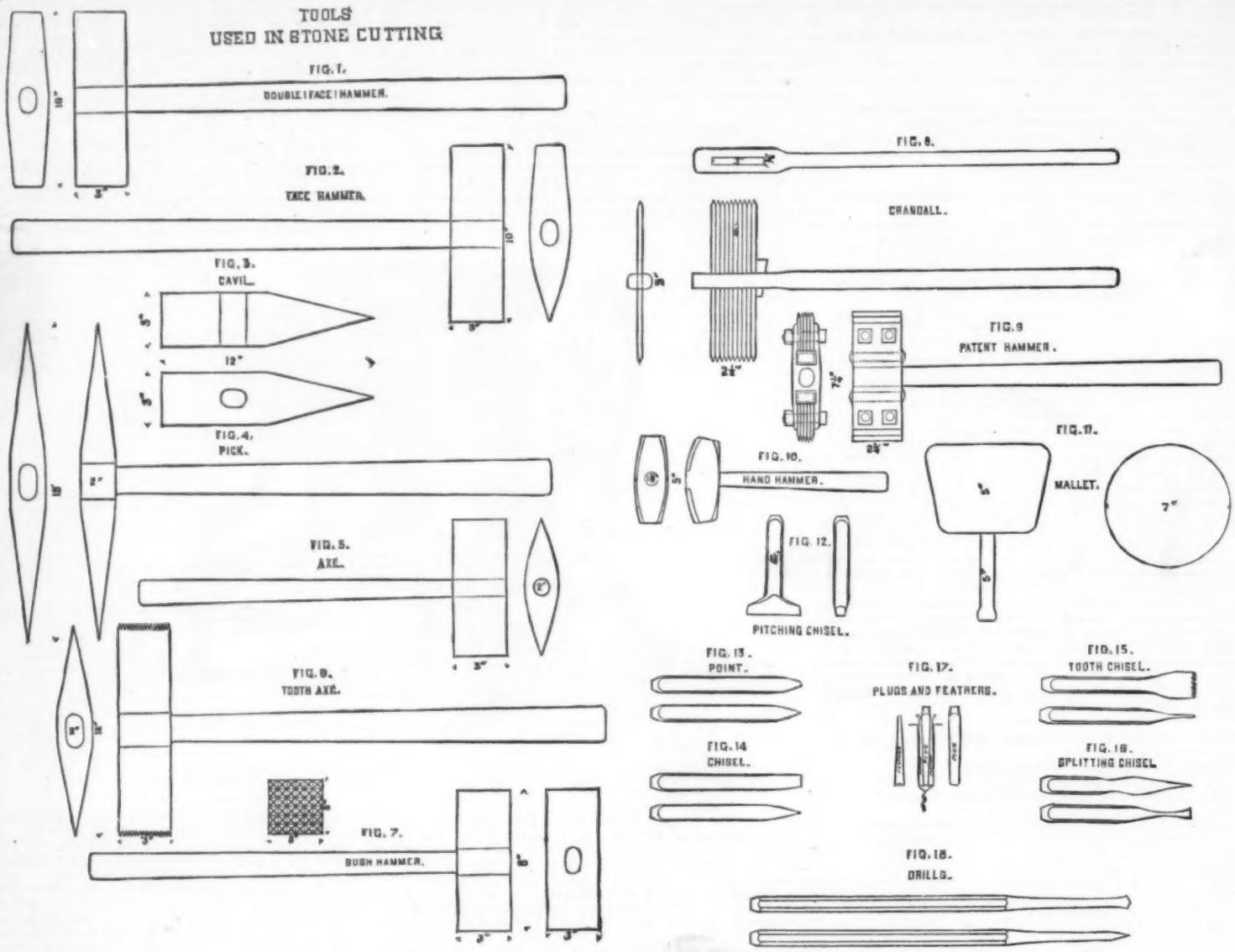
A number of oil wells are being sunk at Emporium and other places in that vicinity along the line of the Philadelphia and Erie, and Philadelphia, New York, and Buffalo railroads.

The Lutheran Church in Beaver City, Pa., has an oil well on its premises, and the flow is sufficient to pay all the church's expenses.

Pipes are now being laid down from the petroleum wells in Russia to the Black Sea, where the ships are to be loaded by pumps.

The Oil City *Derrick* predicts that oil will sell at forty cents a barrel within the next few months unless a curtailment of the present immense over-production is at once enforced.

DISCOVERY OF OIL IN THE BLACK HILLS.—A bottle of petroleum was brought into Deadwood, Dakota Territory, on December 17, 1877, from an oil well that was discovered a few weeks ago eight miles from Jenny's Stockade and 100 miles south of Deadwood. The petroleum is pronounced by experts to be equal to that of West Virginia.



TOOLS USED IN STONE CUTTING.

NOMENCLATURE OF BUILDING STONES AND OF STONE MASONRY.*

By J. JAMES R. CROES, WILLIAM E. MERRILL, and EDGAR B. VAN WINKLE.

BUILDING stones are classified either in accordance with the manner in which they are individually prepared for use, or in accordance with the manner in which they are aggregated into masonry. The latter classification is in some measure dependent upon the former, as the nomenclature of masonry varies, not only with the combination, but also with the character of the work on the individual stone. The first named classification is that of the stone-cutter, and the other that of the mason.

The object of this paper is to discuss building stones from these two standpoints, with the view of obtaining a uniform nomenclature. The use of the same terms throughout the United States would prevent misunderstandings and make engineering practice more uniform, and better understood when records of completed work are examined. The present diversity of nomenclature is unsystematic and objectionable on many grounds.

TOOLS USED IN STONE-CUTTING.

In order to describe intelligibly the various kinds of building stones, it will be necessary to begin with a description of the tools used in stone-cutting, as the names of many kinds of dressed stones are directly derived from those of the tools used in dressing them.

Formerly stone-cutters' tools were made of iron with steel edges; the modern practice is to make them wholly of steel.

The *Double Face Hammer* (Fig. 1) is a heavy tool weighing from 20 to 30 lbs., used for roughly shaping stones as they come from the quarry and for knocking off projections. This is used only for the roughest work.

The *Face Hammer* (Fig. 2) has one blunt and one cutting end, and is used for the same purpose as the double face hammer, where less weight is required. The cutting end is used for roughly squaring stones preparatory to the use of finer tools.

The *Cavil* (Fig. 3) has one blunt and one pyramidal or pointed end. It weighs from 15 to 20 lbs. Used in quarries for roughly shaping stone for transportation.

The *Pick* (Fig. 4) somewhat resembles the pick used in digging, and is used for rough dressing, mostly on limestone and sandstone. Its length varies from 15 to 24 inches, the thickness at the eye being about 2 inches.

The *Ax* or *Pean Hammer* (Fig. 5) has two opposite cutting edges. It is used for making drafts around the arris or edge of stones and in reducing faces and sometimes joints to a level. Its length is about 10 inches and the cutting edge about 4 inches. It is used after the point and before the patent hammer.

The *Tooth Ax* (Fig. 6) is like the ax, except that its cutting edges are divided into teeth, the number of which vary with the kind of work required. This tool is not used in granite and gneiss cutting.

The *Bush Hammer* (Fig. 7) is a square prism of steel whose ends are cut into a number of pyramidal points. The length of the hammer is from 4 to 8 inches, and the cutting face from 2 to 4 inches square. The points vary in number and in size with the work to be done. One end is sometimes made with a cutting edge like that of the ax.

The *Crandall* (Fig. 8) is a malleable iron bar about two feet long, slightly flattened at one end. In this end is a slot, 3 inches long and $\frac{3}{16}$-inch wide. Through this slot are passed ten doubled-headed points of $\frac{1}{4}$-inch square steel, 9 inches long, which are held in place by a key.

The *Patent Hammer* (Fig. 9) is a double-headed tool so formed as to hold at each end a set of wide thin chisels. The tool is in two parts, which are held together by the bolts which hold the chisels. Lateral motion is prevented by four guards on one of the pieces.

The tool without the teeth is $5\frac{1}{2} + 2\frac{3}{4} + 1\frac{1}{2}$ inches. The teeth are $2\frac{3}{4}$ inches wide. Their thickness varies from $\frac{1}{12}$ to $\frac{1}{8}$ of an inch. This tool is used for giving a finish to the surface of stones.

All of the above-mentioned are two-handed, or require both hands of the workman to use them.

The remaining tools to be described require the use of only one hand for each.

The *Hand Hammer* (Fig.) 10), weighing from two to five pounds, is used in drilling holes and in pointing and chiseling the harder rocks.

The *Mallet* (Fig. 11) is used where the softer limestones and sandstones are to be cut.

The *Pitching Chisel* (Fig. 12) is usually of $1\frac{1}{4}$ inch octagonal steel, spread on the cutting end to a rectangle of $\frac{1}{2} + 2\frac{1}{2}$ inches. It is used to make a well defined edge to the face of a stone, a line being marked on the joint surface, to which the chisel is applied, and the portion of the stone outside of the line broken off by a blow with the hand hammer on the head of the chisel.

The *Point* (Fig. 13) is made of round or octagonal rods of steel, from $\frac{1}{4}$ inch to 1 inch diameter. It is made about 12 inches long, with one end brought to a point. It is used until its length is reduced to about 5 inches. It is employed for dressing off the irregular surface of stones, either for a permanent finish or preparatory to the use of the ax. According to the hardness of the stone, either the hand hammer or mallet is used with it.

The *Chisel* (Fig. 14), of round steel of $\frac{1}{4}$ to $\frac{3}{4}$ inch in diameter and about 10 iches long, with one end brought to a cutting edge from $\frac{1}{4}$ inch to 2 inches wide, is used for cutting drafts or margins on the face of stones.

The *Tooth Chisel* (Fig. 15) is the same as the chisel, except that the cutting edge is divided into teeth. It is used only on marbles and sandstones.

The *Splitting Chisel* (Fig. 16) is used chiefly on the softer stratified stones and sometimes on fine architectural carvings in granite.

The *Plug*, a truncated wedge of steel, and *the Feathers*, of half-round malleable iron (Fig. 17), are used for splitting unstratified stone. A row of holes is made with the *Drill* (Fig. 18) on the line on which the fracture is to be made. In each of these holes two feathers are inserted, and the plugs lightly driven in between them. The plugs are then gradually driven home by light blows of the hand hammer on each in succession until the stone splits.

In architectural carving, a variety of chisels of different forms are used. For most of these no specific names exist, and their shapes are varied with the special work to be done.

STONE CUTTING.

All stones used in building come under one of three classes, viz.:

I.—Rough stones that are used as they come from the quarry.

II.—Stones roughly squared and dressed.

III.—Stones accurately squared and finely dressed.

In practice, the line of separation between them is not very distinctly marked, but one class gradually merges into the next:

I.—*Unsquared Stones or Rubble.*—This class covers all stones which are used as they come from the quarry, without other preparation than the removal of very acute angles and excessive projections from the general figure. The term "backing" which is frequently applied to this class of stone is inappropriate, as it properly designates material used in a certain relative position in a wall, whereas stones of this kind may be used in any position.

II.—*Squared Stones.*—This class covers all stones that are roughly squared and roughly dressed on beds and joints. The dressing is usually done with the face hammer or the ax, or in soft stones with the tooth hammer. In gneiss it may be necessary to use the point sometimes. The distinction between this class and the third lies in the degree of closeness of the joints which is demanded. Where the dressing on the joints is such that the distance between the general planes of the surfaces of adjoining stones is one-half inch or more, the stones properly belong to this class.

Three subdivisions of this class may be made, depending on the character of the face of the stone:

(*a.*) *Quarry-faced* stones are those whose faces are left untouched as they come from the quarry.

(*b.*) *Pitched-faced* stones are those on which the arris is clearly defined by a line beyond which the rock is cut away by the pitching chisel, so as to give edges that are approximately true.

(*c.*) *Drafted* stones are those on which the face is surrounded by a chisel draft, the space inside the draft being left rough. Ordinarily, however, this is done only on stones in which the cutting of the joints is such as to exclude them from this class.

In ordering stones of this class the specifications should always state the width of the bed and end joints which are expected, and how far the surface of the face may project

* A paper read before the American Society of Civil Engineers, November 7th, 1877.

beyond the plane of the edge. In practice the projection varies between 1" and 6". It should also be specified whether or not the faces are to be drafted.

III.—*Cut Stones.*—This class covers all squared stones with smoothly-dressed beds and joints. As a rule, all the edges of cut stones are drafted, and between the drafts the stone

FIG. 19.

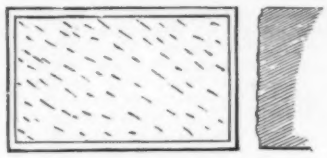
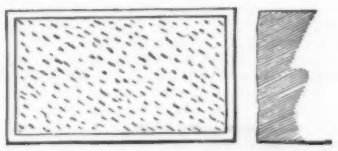


FIG. 20.



is smoothly dressed. The face, however, is often left rough, when the constructions are massive.

In architecture there are a great many ways in which the faces of cut stone may be dressed, but the following are those that will usually be met in engineering work:

Rough Pointed.—When it is necessary to remove an inch or more from the face of a stone, it is done by the pick or heavy points until the projections vary from ½" to 1". The stone is then said to be rough pointed. This operation precedes all others in dressing limestone and granite.

Fine Pointed.—If a smoother finish is desired, rough pointing is followed by fine pointing, which is done with a fine point. It is only used where the finish made by it is to be final, and never as a preparation for final finish by another tool.

Crandalled.—This is only a speedy method of pointing, the effect being the same as fine pointing, except that the dots on the stone are more regular. The variations of level are about ⅛", and the rows are made parallel. When other rows, at right angles to the first, are introduced, the stone is said to be *cross-crandalled.*

Axed or Pean Hammered and Patent Hammered.—These two vary only in the degree of smoothness of the surface which is produced.

The number of blades in a patent hammer varies from 6

Fig. 21.

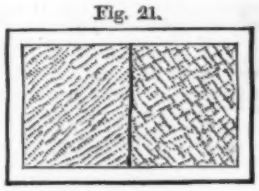


Fig. 22.

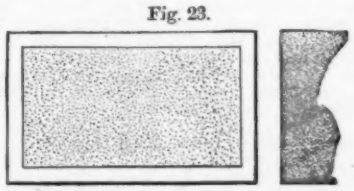
to 12 to the inch, and in precise specifications the number of cuts to the inch must be stated, such as 6-cut, 8-cut, 10-cut, 12-cut. The effect of axing is to cover the surface with chisel marks, which are made parallel as far as practicable. Axing is a final finish.

Tooth Axed.—The tooth ax is practically a number of points, and it leaves the surface of a stone in the same condition as fine pointing. It is usually, however, only a preparation for bush hammering, and the work is then done without regard to effect so long as the surface of the stone is sufficiently leveled.

Bush Hammered.—The roughnesses of a stone are pounded off by the bush hammer, and the stone is then said to be "bushed." This kind of finish is dangerous on sandstone, as experience has proved that sandstone thus treated is very apt to scale.

In dressing limestone which is to have a bush hammered finish, the usual sequence of operations is: 1st, rough pointing; 2d, tooth axing; 3d, bush hammering.

Fig. 23.



Rubbed.—In dressing sandstone and marble, it is very common to give the stone a plane surface at once by the use of the stone saw. Any roughnesses left by the saw are removed by rubbing with grit or sandstone. Such stones, therefore, have no margins. They are frequently used in architecture for string courses, lintels, door jambs, etc., and they are also well adapted for use in facing the walls of lock chambers, and in other localities where a stone surface is liable to be rubbed by vessels or other moving bodies.

RUBBLE

Fig. 26
COURSED RUBBLE.

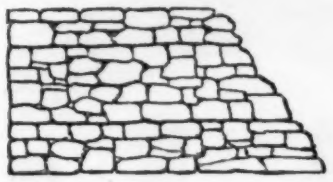
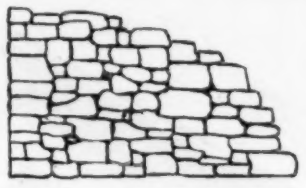


Fig. 27
UNCOURSED RUBBLE.



SQUARED STONE.

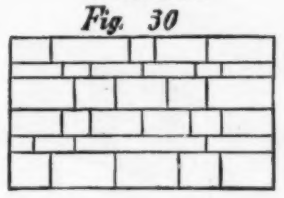
QUARRY FACED

Fig. 28

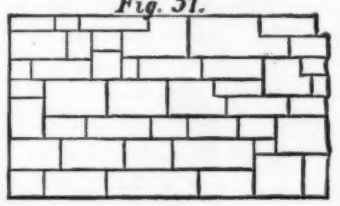
PITCH

Fig. 29

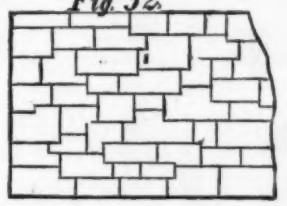
RANGE.
Fig. 30



BROKEN RANGE
Fig. 31.



RANDOM.
Fig. 32.



ASHLAR.

Fig. 33. ASHLAR.

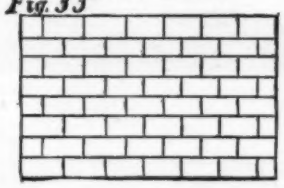
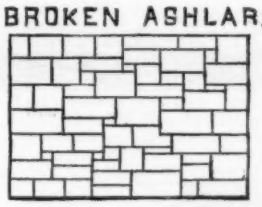


Fig. 34

BROKEN ASHLAR.



NOMENCLATURE OF BUILDING STONES AND OF STONE MASONRY.

Diamond Panels.—Sometimes the space between the margins is sunk immediately adjoining them, and then rises gradually until the four planes form an apex at the middle of the panel. Such panels are called diamond panels, and, in the case described, the panel is a sunk diamond panel. When the surface of the stone rises gradually from the inner lines of the margins to the middle of the panel, it is called a raised diamond panel. Both kinds of finish are common on bridge quoins and similar work. The details of this method of dressing should be given in the specifications.

MASONRY.

As the term stone masonry includes properly all classes of construction in stone which require the employment of skilled mechanics or masons, any class of masonry may be laid dry, in lime mortar or in cement mortar, at will. On this point specifications should always be precise.

(1) *Rubble Masonry.*—This is composed of unsquared stones. It may be *Uncoursed Rubble* (Fig. 26), laid without any attempt at regular courses, or *Coursed Rubble* (Fig. 27), leveled off at specified heights to a horizontal surface. The stone may be required to be roughly shaped with the hammer, so as to fit approximately.

(2) *Squared Stone Masonry.*—According to the character of the face, this is classified as *Quarry-faced* (Fig. 28), or as *Pitch-faced* (Fig. 29). If laid in regular courses of about the same rise throughout, it is *Range* work (Fig. 30). If laid in courses that are not continuous throughout the length of the wall, it is *Broken Range* work (Fig. 31). If not laid in courses at all, it is *Random* work (Fig. 32), and this is generally to be expected of this kind of masonry, unless the specifications call for *Range* work.

In quarry-faced and pitch-faced masonry, quoins and the sides of openings are usually *hammer-dressed.* This consists in removing projections so as to secure a rough-smooth surface, and is done with the face hammer, the plain ax, or the tooth ax. This work is a necessity where door or window frames are inserted, and it greatly improves the general effect of the wall if used wherever a corner is turned.

(3) *Ashlar Masonry.*—This is equivalent to "cut-stone masonry," or masonry composed of any of the various kinds of cut stone mentioned above. As a rule the courses are continuous (Fig. 33), but sometimes they are broken by the introduction of smaller stones of the same kind, and then it is called *Broken Ashlar* (Fig. 34). If the stones are less than one foot in height, the term *Small Ashlar* is proper. The term *Rough Ashlar* is sometimes given to squared stone masonry, either "quarry-faced" or "pitch-faced," when laid as range work; but it is believed that it is more logical and more expressive to call such masonry "squared range work." From its derivation, ashlar apparently means large, square blocks, but practice seems to have made it synonymous with "cut stone," and this secondary meaning has been retained for convenience.

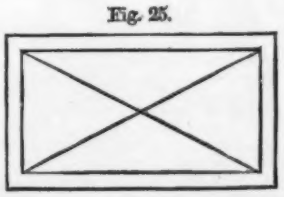
Dimension-stones are cut stones, all of whose dimensions have been fixed in advance. If the specifications for ashlar masonry are so written as to prescribe the dimensions to be used, it will not be necessary to make a new class of such stones.

Range work, whether of squared stones or of ashlar, is usually backed up with rubble masonry, which in such cases is specified as coursed rubble.

Whatever terms are applied in common use to various classes of masonry, it is not safe to trust to them alone in

Fig. 24.

Fig. 25.



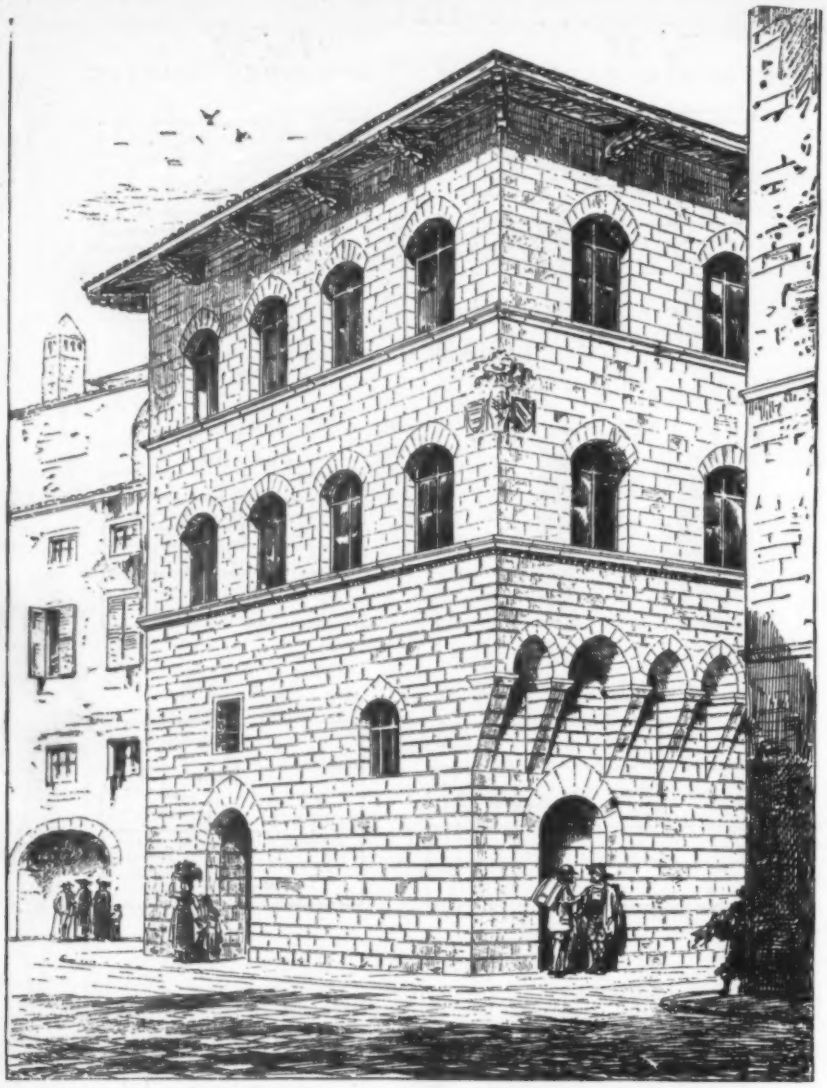
preparing specifications for construction, but every specification should contain an accurate description of the character and quality of the work desired. Whenever practicable, samples of such kind of cutting and masonry should be prepared beforehand, and exhibited to the persons who propose to undertake the work.

"PILING UP" IN CATAMARANS.

To the Editor of the Scientific American:

IN reply to Lawrence L. Duerden's communication in SUPPLEMENT No. 110, I wish to correct the erroneous opinion entertained by many that water has a tendency to "pile up" between the hulls of a catamaran. Experience fails to support such a view, so that the flat sided hulls advocated are of no advantage. On the contrary, the speed must be reduced by such build, as the lines must necessarily be coarser than in symmetrical hulls.

PADDLEFAST.



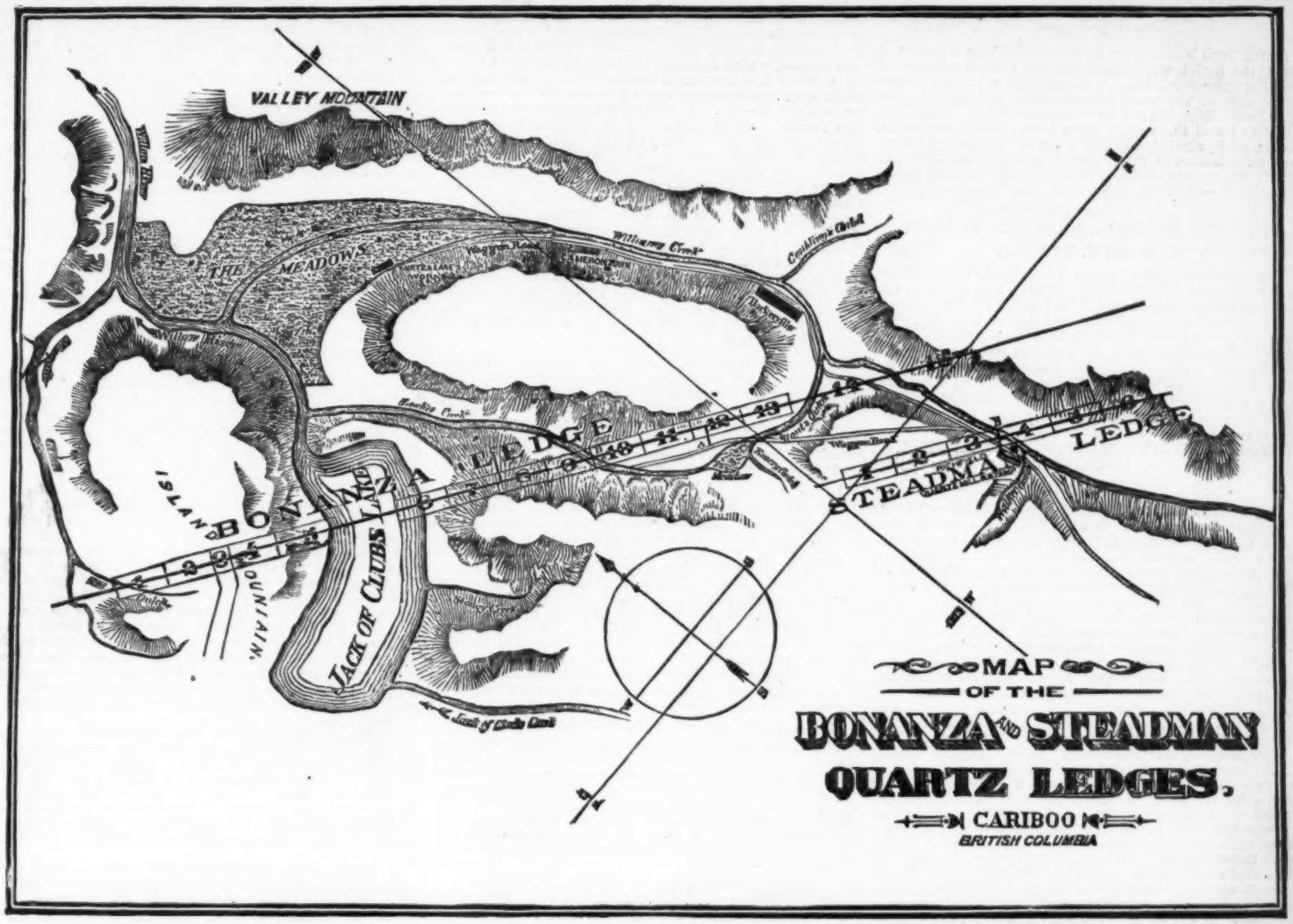
ITALIAN EXAMPLES OF DOMESTIC ARCHITECTURE.

EXAMPLES OF DOMESTIC ARCHITECTURE OF FRANCE AND ITALY.

Mr. Anderson's "Examples," although they may be thought by some to come rather late in the day, do not in any way cover the ground already taken up—indeed there is a freshness in almost all the subjects which commends the collection at once to our notice. The buildings themselves may be well known, but measured drawings of them have not before been given—not, at any rate, in so complete a form, and the fact of their being of a domestic character renders the book of special interest and value. The period of the subjects chosen for illustration extends from the twelfth to the fifteenth century. The plates are executed in line lithography by the author in a clear and technical manner, to scales of practical value, and a few views are added, chiefly lithographed by the pen of Mr. A. H. Haigh, from the author's sketches, and of these our selection to-day consists. The number of the plates are equally divided between France and Italy, and considerable care has been exercised in the arrangement of the subjects, which include houses and shops, warehouses and public buildings, from the market to the palace, and several of the plates are devoted to details, such as dormers, chimneys, windows, and fireplaces, etc., with the mouldings drawn to an enlarged scale, chiefly ¼ full size. The jointing is generally well shown, though, perhaps, at times the drawing lacks force of execution. Of French buildings several sheets are devoted to Cordes, in Languedoc, which town formerly was the summer residence of the Counts of Toulouse. It is picturesquely situated on a conical hill, and is possessed of many fine houses of fourteenth-century date, though they all present a similar style of treatment in the main character of their façades. Their design consists of a series of arches on the ground floor, one of which forms the entrance to the house—the others must either have been used as shops or stores, as they lead to large apartments having generally no communication with the rest of the house. Small windows pierce the spandrels or range immediately over these arches, and seem to have lighted an entresol no longer remaining. Bold string-courses mark the floors of the upper stories, and the windows, chiefly traceried, are spaced singly or in groups of two or three, and they often are furnished with stone seats in the thickness of the wall on the interior side. But little woodwork remains, owing to continued alterations, and the roofs are mostly renovations, even when not of an entirely modern character. Some of these houses had pents over the ground-floor arcade, to protect the shops and people from the sun or rain. Altogether the treatment is suggestive for reasonable shop-building, though it is to be feared that the almost inordinate love of our shop-keepers for plate-glass and display will long prevent features here described from being employed. Suggestive examples are also given by Mr. Anderson from St. Junien, Figeac, St. Antonin, Chateldon (half-timbered), and Rocamadour. Several features and details of good character are selected from buildings at Vitteaux, Liseaux, Figeac, Bayeaux, Cluny, etc. The old abbey barn at Ardennes, near Caen, with its fine arcade, is shown, and so are the interesting old markets at Cordes and Caylus. Many similar old market-places remain in France, and these two may be taken as good examples. The former is of fourteenth-century date, and covers an area of 98 ft. × 66 ft. 7 ins. The roof is supported on twenty-four columns, arranged lengthways in four rows. These columns are all octagonal on plan, and are built in courses. They are 1 ft. 10 ins. in thickness, and have caps and bases. The roof is trussed, the only peculiarity about it being the curious manner in which the thrust is thrown as low down the piers as possible by means of struts, which spring from mortises some four courses down the pillar. The roof space is used as a store. The second illustration from Caylus is of a market much smaller, measuring only 44 ft. 6 ins. × 27 ft 2 ins. Of the two examples, however, this is perhaps the more interesting. It is inclosed by a dwarf wall, with openings on all sides. The piers are of the same character as already described. A curious set of grain measures, in the form of basins sunk in the coping of the boundary wall, exist, and are well shown here by a perspective sketch. Turning to the sketches selected from Italian examples, we note some interesting specimens of the beautiful brickwork characteristic of that style which not long since found so much favor in this country. The manner of its treatment will ever remain as a leading guide in the use either of terra cotta or of simple brickwork, whatever may become of the style itself, strictly speaking. Mr. Anderson has given many views, as well as details, which are new and not before published, and of these are those which we illustrate to-day. The views from Viterbo are very interesting. This important city was a gift to the Holy See in the twelfth century by the Countess Matilda, and to this period belong many of the numerous fragments of domestic architecture still remaining. The more noticeable features of these old houses are the balconies and outside stairs; of the former that from the Piazza Pellegrini, once the center of the best mediæval houses in the town, but now of squalid dirt and misery. The upper part of the inside of this house has been utterly destroyed. On plan the loggia is about 18 ft. × 10 ft., and is approached by the steps shown in the view, which also lead to the house. A bench extends along the front and far end, where a private staircase connects the gallery with the room behind. The sections of the mouldings are exceedingly good, and the star and nail-head ornaments are profusely used here, as in all the early work of Viterbo. The outside staircase of the house known as Santa Rosa is herewith given. It is of the same period as the house in the Piazza Pellegrini, and, like it, is much destroyed.

Restorations of these buildings are given in MM. Verdier et Chattois' French work. A very large but utterly ruined house, one of the principal in the city formerly, is the old family mansion of the builders of the magnificent Fontana Grande of Viterbo. It is situated at the Casa Gatteselia. A good house may also be seen in Toscanella, at the Casa Spagnuola. We also publish Mr. Anderson's sketch from Florence, which still retains many mediæval houses, all being marked by the stern character illustrated in that before us. The only variety of detail is to be found in the string-courses. The windows seldom if ever have mullions or tracery, and are invariably arched with semi-circular or segmental arches, without mouldings of any kind. The brick house from Montepulciano, which completes our sheet, is of the same character as that last referred to. It has the same projecting or corbelling over of the upper stories, which adds so greatly to their picturesque effect.

Montepulciano is a small town perched on a high hill between Sienna and Orvieto, and is more celebrated for its wine than architecture. These views which we have thus described may be taken as fair examples of the drawings in Mr. Anderson's book. We should like, however, before concluding our remarks, to note a discrepancy which exists between the details of the Palace of the Jurisconsults, Cre-



mona, as here given by Mr. Anderson, and by Mr. Street in his "Brick and Marble Architecture in Italy;" and as this is probably the only building illustrated in both works, the non-agreement of the details is singular, though perhaps it would scarcely be fair to take them as a test of the accuracy of the whole drawings in either book. The general drawings agree tolerably well, but the detailed section of the beautiful windows is quite otherwise. Mr. Street shows a bold projection or rather deep recessing of the window jambs: Mr. Anderson renders them almost flat; the former is probably the more correct, but what shall be said of the unique chimney which both architects show in detail? The drawings are in either case both clear and well-drawn, but "when doctors differ who shall agree?" may well here be asked by the student. The printing of Mr. Anderson's "Examples" is well executed by Mr. William Mackenzie, Glasgow, who also published the work, which certainly is deserving of a place on the bookshelves of all architects and students. The book is dedicated to Sir George Gilbert Scott, R. A.—*Building News.*

THE CARIBOO QUARTZ LEDGES.

WE present herewith a diagram of the Bonanza and Steadman ledges, recently discovered in the Cariboo mining district, British Columbia. By referring to the diagram, the letters indicate the following claims on the Bonanza ledge: 1, British Columbia M. & W. Co.; 2, Ring Co.; 3, C. Sadow, Crown Grant, 4, Australian Co.; 5, Dunlevy Co.; 6, Pinkerton Co.; 7 and 8, Enterprise Co.; *C*, tunnel of the Enterprise, now under way, estimated length 275 feet. This will cut the ledge 150 feet from the surface. Elevation of ledge at this point, 1,200 feet above bed of Lowhee creek; width of ledge on the surface, 18 to 20 feet; 9 represents the location of the Lone Star Co.; 10, Pinkerton Co.; *D* is the Victoria Gravel Mining Company's shaft.

At a depth of 130 feet the ledge was struck in a drift and found to be 30 feet wide, assays averaging $36 per ton; 11 is the American Co.'s ground; 12, Cariboo Quartz M. Co.; *A* is the tunnel of the Cariboo, cutting the ledge 52 feet below the surface. At this point the vein is 22 feet wide, giving assays ranging from $14 to $155 per ton; average, $33. No. 13 is the St. Lawrence M. Co.; 14, Wintrip Co., Crown grant; 15, Black Jack Co, Crown grant.

On the Steadman ledge, No. 1 is the McKenzie Co.; 2, British Columbia M. & M. Co.; 3, S. Walker; *B*, croppings, assayed $20 to $30 per ton and worked $13.25; ledge five feet wide. No. 5 is the Cariboo Quartz M. Co.; and 6, the Consolidated Virginia Co.

The work of development has commenced in earnest, and indications all point to the opening of a large and productive quartz mining region. The present government of the province is active in promoting the development of the country, and a few months since engaged Mr. R. B. Harper, an old and experienced quartz miner, to visit the Cariboo region and give the quartz prospects a careful examination. Mr. Harper, after a careful investigation, satisfied himself of the existence of paying quartz, and under his direction tunnels were run which demonstrated beyond a doubt the correctness of his theories.

The principal claims are located upon the "Big Bonanza" ledge, situated on the summit of the mountain back of Barkerville. The ledge is a true fissure vein with well defined walls, and has been traced for a distance of five miles. The Cariboo Quartz M. Co.'s tunnel has cut the ledge at a distance of 52 feet from the surface. At this point the vein is 22 feet in width, with assays ranging from $14 to $155 to the ton. The average assays across the vein show $33 per ton. The ore is a soft quartz, carrying free gold and sulphurets, with a slight trace of silver. A four-stamp mill, with imperfect appliances, has been busily engaged in running upon rock from this claim for most of the time since October 8th, 1877, with the most satisfactory result. The gross yield for two months to December 1st may be put down at $5,000. The company has decided to erect a first-class 20-stamp mill at once, and Mr. Harper is now having the plans and specifications prepared in this city.

Adjoining the Cariboo claim on the south is the St. Lawrence location of 1,500 feet. In this claim a cut has been run across the vein, showing the same character of ore found in the Cariboo. It is proposed to open the St. Lawrence by a tunnel 350 feet in length, which will cut the vein at a depth of 100 feet from the surface.

The American Company's claim adjoins the Cariboo on the north. An open cut has been run across the vein, showing the same kind of ore disclosed in the Cariboo and St. Lawrence. A tunnel is projected by this company which will cut the vein 150 feet from the top.

The Pinkerton lies next to the American. The ledge in this location has been cut through by Lowhee creek in the Victoria shaft, at a depth of 350 feet from the croppings of the Cariboo location. Where exposed by the Victoria shaft it is 30 feet wide, averaging $36 per ton in gold, with traces of silver.

The British Columbia Mill and Mining Company have decided to order a 20 stamp mill. The Enterprise mine lies next, to the north of the Pinkerton; is being energetically developed, and a mill will be erected. There is probably no doubt that the Big Bonanza ledge is the feeder of the famous Williams and Lowhee creeks, and the mother lode of the country. The yield from these creeks since 1862 amounts to the astounding sum of $40,000,000. All placer gold is made up of particles and detached fragments which once formed a part of some vein, and from which they have been detached by various mechanical causes, especially by the action of currents of water. The creeks below the ledge were astonishingly rich, and it is a fair inference that this ledge was the source of the placers. The conditions for successful quartz mining in the district Mr. Harper represents to be extremely favorable. Wood is $4 per cord and water power is abundant. Labor is plentiful. The winters in Cariboo are severe, but no more so than in many elevated localities in California and Colorado where mining is carried on all the year through. The location of the Big Bonanza ledge is such as to admit of its being worked by tunnels, thus enabling the miner to deliver his ore at the mills without exposure to the weather. The Canadian transcontinental railway may now be considered a fixed fact. The road will traverse this region. Exhaustive surveys have been made, and a portion of the road, Pembina, already constructed. Barkerville is connected with San Francisco by wire, and communication with the mines can easily be had at all times. The telegraph line to Barkerville was constructed by the Western Union Telegraph Company some years ago, when that corporation was endeavoring to build an overland line via Behring's Straits to Asia. The scheme was abandoned after the Atlantic cable was successfully laid, and the line as far as built turned over to the Provincial Government. Mr. Harper represents that there is great rejoicing among our neighbors over the new developments. Property has advanced in Victoria and elsewhere in the province, and British Columbia seems to have entered upon a new career of prosperity. It is a matter of great congratulation that another productive gold region has been opened, as San Francisco must feel the benefit of such discoveries in the demand for mining machinery and mining supplies of every description.—*Mining and Scientific Press.*

BOXWOOD.

IT appears that, in consequence of the continued increased cost of boxwood and its rapid decrease in quality, one of the principal importers of this and other hard woods into this country has succeeded in introducing two American woods to be used instead of box in the manufacture of shuttles, a purpose for which immense quantities of boxwood have hitherto been used. The woods so substituted are those of the cornel and persimmon. The first is apparently the *cornus florida*, a deciduous tree, about 30 ft. high, growing abundantly in woods in various parts of North America. The wood, though of small size, is hard, heavy, and close-grained, and is used chiefly in America for the handles of tools and for shuttle-making, and, when properly seasoned, is much superior to Persian boxwood. The same may be said of the persimmon (*diospyros virginiana*), a tree belonging to the ebony family, a native of the United States, where it grows to a height of from 50 ft. to 60 ft., and a diameter of a foot or 18 ins. The heartwood is of a dark brown color and very hard. The trunk is covered with a very thick, hard, and rugged bark. One great point to be particularly remembered in the preparation of these woods for shuttle-making is the very gradual drying by artificial means; this is more particularly recommended in the case of the cornel, undue haste in seasoning, it is said, having in some cases created a prejudice against the wood. As an illustration to some extent of the effects of the war, it may be stated that while in 1876 over 10,000 tons of boxwood were imported, the year just passed shows a return of only between 4,000 and 5,000 tons. A large proportion of this wood is the produce of the forests on the Caspian Sea. Though the supply from the Black Sea provinces has for some years past been decreasing, it is well known that untouched forests of the wood exist in Russian territory, and it is hoped and expected that at the close of the present disastrous war these forests may be opened up, so that we may get abundant supplies of good wood for some time to come.—*Journal of the Society of Arts.*

ROOFING PAINT.

SPARHAM'S Roofing is said to be composed of soapstone, mica and plumbago, ground rather fine. These ingredients are mixed with tar, and are applied over felt in place of gravel and pitch. The tar used with this cement is coal tar, not boiled; it therefore is not liable to crack like gravel roofs. The mixture is applied, two-thirds cement and one-third tar, with a trowel, ¼ to ½ of an inch in thickness. This mixture unites and forms a substance like rubber, and a resistance to water, cold and heat. When properly mixed as stiff mortar, can be applied to roofs that have a pitch of from ½ inch to 3 inches to the foot, and will not run in summer weather nor crack in winter, is water-proof; mixed thin and applied like paint on wooden battlements or other wood work, will preserve the wood, and can be applied to tin or zinc roofs, preventing rust and stopping leaks when properly applied.

NEW RED COLORING MATTER FROM PEACH LEAVES.

By C. Bougarel.

After fresh leaves of the peach-tree had been treated with ether, the liquid was poured off and alcohol substituted. Two days afterward there were observed on the leaves and on the sides of the vessel brilliant scales of a greenish color by reflected light, but red by transmitted light. These crystals were found to be insoluble in water, nearly insoluble in alkalis, acids, alcohol, and ether, but very soluble in chloroform and benzine, to which they imparted a beautiful rose color. The author proposes to call this red coloring matter *erythrophyll.*—*Bull. Soc. Chim.*

COLORING MATTER OF VELELLA LIMBOSA.

By A. and G. De Negri.

This pelasgic mollusk, which is only rarely thrown up on the beach, gives a blue coloring matter which is readily distinguished from that of murex and aplysia by the absence of absorption-bands, when examined spectroscopically. The coloring matter is very fugitive, disappearing rapidly on the death of the animal. It is insoluble in ether, chloroform, benzine, and carbon bisulphide, but soluble in water, the solution turning yellow when heated; acids turn it red, and it is decolorized by the hypochlorites.—*Gazzetta Chimica Italiana.*

THE COLORING MATTER OF "BOLETUS LURIDUS."

By G. Cugini.

In 1860 Phipson attributed the purple color which the freshly-cut surface of *B. luridus* and *B. cyanescens* show when exposed for a short time to the air, to aniline; the author finds, however, that the coloration is not produced by oxidation, but by the action of ammonia. The extract obtained by treating the fungus with dilute alcohol yields nothing to ether, showing that no aniline is present. The extract is strongly acid, and is colored blue by ammonia in small quantity, although excess of the alkali destroys the color; potassium hydrate gives a deep wine-yellow. Ferric chloride gives a green color, and tincture of iodine a greenish-brown color. The author did not succeed in isolating any crystalline substance.—*Gazzetta Chimica Italiana.*

CHEMISTRY AND MINERALOGY.

Liquefaction of the "Permanent" Gases.—The first number of the new weekly scientific journal (*Revue Internationale des Sciences*, 3 Janvier, 1878) contains a detailed account of the method by which M. Raoul Pictet, of Geneva, has succeeded in liquefying oxygen. A description of the process has also been communicated by M. Pictet to *The Chemical News*, and appears in the number of that journal of the 4th inst., illustrated with drawings of the apparatus with which the grand result has been achieved. He first prepares liquid sulphurous acid, with which he fills a horizontal tube, rather more than a meter in length and 12 centimeters in diameter. When an exhaust-pump attached to one end of this tube is set in operation, the temperature of this liquid rapidly falls to —60° or even —70°. This sulphurous acid is now used to condense carbonic acid. Along the axis of the tube already referred to passes a smaller tube (like the central tube of a Liebig's condenser) through which carbonic acid under a pressure of from four to six atmospheres is transmitted; the gas, which readily liquefies under these circumstances, is conveyed to a copper tube, 4 meters in length and 4 centimeters in diameter, where it is stored. When sufficient material has been obtained, it in like manner is cooled by its rapid evaporation. An exhaust-pump attached to this tube makes 100 revolutions a minute and removes 3 liters per stroke; the carbonic acid soon solidifies and its temperature falls to about —140°. We now come to the third stage of the experiment, the condensation of the oxygen. Along the axis of the copper tube containing the frozen gas passes a smaller tube, just as in the former case; this one is 5 meters in length and 14 millimeters in external and 4 millimeters in internal diameter; it consequently extends beyond the copper tube at both extremities. It is connected at one end with a large howitzer shell, the sides of which are 35 millimeters in thickness, while its height is 28 centimeters and diameter 17 centimeters; at the other end is a Bourdon gauge, graduated to record pressures up to 800 atmospheres, and beyond it a screw-tap which closes the tube. The shell which constitutes the retort for the preparation of the oxygen contains 700 grammes of potassium chlorate and 250 grammes of potassium chloride, mixed and perfectly dry. When the freezing material is at its lowest temperature heat is applied to the shell, and at the time that the reaction is complete the pressure rises to above 500 atmospheres, but it almost immediately sinks and falls to 320 atmospheres. On opening the screw-tap at the other end of the tube a jet of liquid issues with extreme violence. On closing the tap and opening it again after a few moments, a second and smaller amount of the liquid oxygen is driven out. The experiment was repeated by M. Pictet a few days later with the same result; and still more recently he examined the escaping jet with the electric light, when it appeared to consist of two parts; one, the central part, was some centimeters in length, and of a whiteness which showed that the element was liquid or even solid; the other, the outer portion, had a blue tint which indicated the presence of oxygen, "compressed and frozen in the gaseous state." Charcoal, rendered slightly incandescent, when placed in the jet bursts into flame with unprecedented violence (*avec une violence inouïe*). It appears that M. Pictet has devoted more than three years to the object of demonstrating experimentally that molecular cohesion is a general property of bodies to which there is no exception. M. Pictet's important discovery closely follows that of M. Cailletet, who in the last week of November announced to the Academy of Sciences of Paris that he had reduced nitrogen dioxide to the liquid state. Cailletet succeeded in liquefying nitrogen dioxide by subjecting it to a pressure of 104 atmospheres at —11° C. At 8° this substance retains its gaseous condition, even under a pressure of 270 atmospheres. Marsh gas under great pressure exhibited a remarkable appearance. When the pressure, equal to 180 atmospheres at 7°, was suddenly reduced, a cloud appeared such as is observed when the pressure on liquid carbonic acid is rapidly diminished. From this the author has been led to believe that the conditions under which this gas becomes liquid had almost been attained. Andrews has shown that in the case of each vapor there exists a "critical point" of temperature, above which no gas can be liquefied, no matter how great the pressure to which it may be subjected. In the case of nitrogen dioxide the "critical point" appears to lie between 8° and —11° (*Compt. Rendus*, 1877, lxxxv., 1016). These results, it would be thought, are astonishing enough, "but more remains behind." At the meeting of the Academy of Sciences held the last week of the old year a sealed packet was opened, which disclosed the fact that on December 2 M. Cailletet had succeeded in liquefying oxygen and carbonic oxide under a pressure of 300 atmospheres, and at a temperature of —29°. It was not communicated directly to that learned body on account of M. Cailletet being at the time a candidate for a seat in the Section of Mineralogy. Cailletet's process consists in subjecting the gas to enormous pressure and the cooling effect of sulphurous acid. The oxygen apparently was not condensed under these circumstances; but on the pressure being relieved, a cloud was formed as in the case of marsh gas. With the only remaining "permanent" gases, however, he has been more successful On the last day of the year he subjected nitrogen to a pressure of 200 atmospheres, and obtained liquid drops of that element. Hydrogen first subjected to a pressure of 280 atmospheres, and then cooled by the removal of that pressure, formed "a cloud." Air subjected to the same treatment was also liquefied, and a jet of liquid air issued from the apparatus.

Bolivite and Taznite.—Domeyko communicates some further notes on the mineralogy of Bolivia, Peru and Chile (*Compt. Rendus*, November 19, 1877). Bolivite is the name which he has given to a bismuth oxysulphide composed of the protosulphide Bi_2S_3 and of the sesquioxide Bi_2O_3. Taznite is a chlorarsenate and chlorantimonate of bismuth, which has been found at Tazna, in Bolivia. Several more curious bismuth minerals are referred to in his paper.

Iodous Acid.—Ogier has studied the action of ozone on iodine (*Comptes Rendus*, November 19, 1877). He obtains the same product when ozonized oxygen is allowed to act on iodine vapor and when a mixture of iodine and oxygen is exposed to the silent electrical discharge. The final product of the reaction is a colorless substance which is unchanged in air, is and soluble in water without apparently undergoing decomposition; the ratio of iodine to oxygen present in this body points to its being iodic acid. Another compound which was but slightly soluble in water was obtained; it exhibited characters which resemble those of the hypoiodic acid of Millon. Ozone when placed in contact with iodine at 44° to 50° appears to form iodous acid; this is a pale yellow, exceedingly light powder, which in contact with water deposits iodine.

The Edible Clay of New Zealand.—Muir has analyzed a specimen of clay from Simon's Pass Station, Mackenzie County, in the South Island, which is eaten in very considerable quantities by the merino sheep grazing on the low bare hills of that region, without their apparently being any the worse for it (*Chemical News*, 1877, xxxvi., 202). The shepherds ascribe the desire of their flocks to consume this material to the fact of the clay containing salt, and this theory is supported by the results of Muir's analysis, which is as follows:—

Silicic acid	61·25
Alumina	17·97
Ferric oxide	5·73
Lime	1·91
Magnesia	0·87
Alkalies (chiefly Sodium chloride)	3·69
Organic matter	1·77
Water	7·31
	100·49

Iridescent Glass.—Vessels of iridescent glass have, during the past year, filled the windows of our shops and the decorated saloons of art and "culture." The process for preparing them appears to have been devised by M. L. Clémandot, who has patented his method in France, England, and America. He submits the vessels to the action of dilute hydrochloric or sulphuric acid, under a pressure of from two to six atmospheres, and produces in this way the effect of the decomposition of light from thin films which, in the ordinary course of things, result from the "weathering" action of time on glass.—*Academy.*

NEURINE.

This alkaloid, existing in the yelk of egg and in bile, has lately been used with good success in diphtheria, and deserves to be further studied. Neurine has been variously identified heretofore with chlorine, sinkaline, trimethyl-oxyethyl-ammonium-hydroxide, hydroxethylen-trimethyl-ammonium-hydrate. It has, however, been recognized as trimethyl-vinylammonium-hydroxide ($3CH_3.NC_2H_3.HO$ or $C_5H_{13}NO$), and it is regarded as identical with amantine, a non-poisonous alkaloid, occurring in certain poisonous mushrooms. Its mode of preparation is the following:

From Eggs.—Yelk of egg is extracted by shaking with ether; the residue is once more extracted with warm alcohol, the ethereal and alcoholic solutions are mixed together and distilled, and the residue in the flask boiled for one hour with excess of solution of baryta. The latter having been precipitated by passing carbonic acid through the mixture, the whole is filtered, the filtrate evaporated at about 80° C. to the consistence of syrup, and extracted with absolute alcohol. The alcoholic solution is then precipitated by platinum chloride, whereby a double chloride of neurine and platinum, insoluble in strong alcohol, is produced. This is collected, dissolved in water, the platinum precipitated by sulphydric acid, and the filtrate evaporated to a syrup, or dried over sulphuric acid in vacuo, or else dissolved in absolute alcohol and covered by a layer of ether. In either case the product is crystallized neurine hydrochlorate. This is then dissolved in water and macerated with freshly precipitated silver oxide, to remove the chlorine. The filtrate, evaporated on the water bath, or, better, dried over sulphuric acid, yields pure neurine.

From Bile.—Bile is boiled with baryta solution in excess, the solution filtered, the filtrate again boiled for twelve hours with baryta-water, then mixed with dilute sulphuric acid, as long as any precipitate is produced, concentrated on the water-bath, and mixed gradually with sulphuric acid, as long as vapors of hydrochloric acid escape. The mass is then extracted with alcohol, the alcoholic solution evaporated, the residue boiled with moist oxide of lead, the filtrate deprived of lead by sulphydric acid, evaporated, and the residue dissolved in absolute alcohol, and, when necessary, filtered. It is then precipitated with platinum chloride and further treated as above stated.

Properties.—Neurine is a colorless, syrupy, hygroscopic, alkaline liquid, which absorbs carbonic acid from the air, and is converted into a carbonate. It is soluble in all proportions in water and alcohol. On boiling its aqueous solution, it is decomposed into trimethylamia and glycol. With acids it forms partly crystallizable, partly deliquescent salts. The hydrochlorate is best prepared by mixing the double chloride of neurine and platinum with potassium chloride and exhausting the dry mass with absolute alcohol. On heating anhydrous neurine hydrochlorate with very concentrated nitric acid in a glycerine bath, it is converted into the poisonous alkaloid muscarine (naturally occurring in poisonous mushrooms), and vapors of nitrous acid escape.

Tests of Purity.—Neurine, as obtained generally from (the lecithine of the) yelk of eggs, should form a clear solution in water and alcohol, and the solution should be strongly alkaline. On mixing 1 gramme of it with 0·6 grammes of powdered oxalic acid, only a trace of carbonic acid should be given off, and, after heating in the water-bath and cooling, a solid saline mass should remain. Viscosity would point to some adulteration, most likely glycerine. On heating it in a small retort, trimethylamia distills over.

Further reports on its use in diphtheria are shortly to be expected.—*Pharm. Centralb.*, 1877.

THE DENSITY OF LIQUID OXYGEN.

The magnificent experimental methods devised by MM. Cailletet and Pictet have already begun to increase the number of the "Constants of Nature." M. Pictet, although in a neck-and-neck race he was beaten by Cailletet in the liquefaction of hydrogen, has left his competitor in the rear with regard to a result of the first importance on the density of oxygen. The noble rivalry between the Ecole Normale Supérieure of Paris and the Atelier de Physique of Geneva bids fair not only to continually increase in interest, but to become the central feature in the progress of physical science for some time.

A telegram from M. Pictet announcing that hydrogen had been solidified was sent to M. Dumas on January 11. The illustrious chemist read the telegram at a sitting of the Société d'Encouragement, of which he was the chairman, and which was holding its regular semi-monthly meeting on that very evening. M. Dumas reminded his hearers, with his wonted force and propriety of expression, that in the first edition of his "Traité de Chimie," published about forty years ago, he had called hydrogen a *gaseous metal.* He said he had been led to hold this view by seeing how small was the affinity of hydrogen for metals and how great for metalloids.

M. Dumas said, moreover, that his peculiar ideas had received some degree of confirmation from the discovery of the large conductibility of hydrogen for heat and electricity, but that the first real demonstration had been given by MM. Cailletet and Pictet. It was for him a great satisfaction having lived long enough to see that most important fact established so clearly "*that you may feel certain, gentlemen, that in drinking a glass of water you are certainly absorbing a metallic oxide.*"

M. Pictet, in the experiments, the results of which were telegraphed to M. Dumas, as we have seen, prepared the hydrogen by the decomposition of potassic formiate by means of potassic hydrate. This reaction, according to Berthelot, gives the gas of the utmost purity. The pressure was commenced at 8.30 P. M.; it was increased gradually, and in a little more than half an hour (at 9.07) it reached 650 atmospheres (9,750 lbs. to the square inch). At this moment the pressure remained stationary for some seconds; the stop-cock was opened, and a jet of a *steel blue color* escaped with a strident noise, comparable to that heard when a bar of iron is plunged into water.

This jet suddenly became intermittent, and the spectators observed a hail of solid corpuscles projected with violence on the ground, where they produced a crackling noise. The stop-cock was then again closed, the manometer indicating 370 atmospheres. This slowly descended to 320, at which point it remained stationary for some minutes. Then it rose to 325 (4,875 lbs. per square inch). The stop-cock was again opened; the jet was now so intermittent that it was believed that an actual crystallization of hydrogen (!) had gone on inside the tube. This was proved by the fact that liquid hydrogen flowed out of the jet when the temperature was increased by the stoppage of the pumps.

M. Dumas, considering oxygen as belonging to the sulphur group, and isomorphous bodies as having the same atomic volume, *i. e.*, the quotient obtained when the atomic weight is divided by the density, had concluded that the atomic volume of sulphur being $\frac{32}{1}$, that of oxygen would be $\frac{16}{1}$, and reciprocally that the density of liquid or solid oxygen would be $\frac{16}{16}$, that is, the atomic volume divided by the atomic weight = 1, which is the density of water.

M. Dumas having communicated these considerations to M. Pictet, has elicited a most interesting response from him. He writes:—

"You arrive at the expression of the density of liquid oxygen as being represented by $\frac{16}{16} = 1 - \delta$ in the solid state, and probably the liquid one also, neglecting the variation due to expansion.

"I have the great satisfaction of being able to announce to you the complete experimental demonstration of the theoretical views enunciated by you now some time ago at Geneva. This demonstration has been arrived at as follows:—

"I know directly and very exactly—

"I. The exact volume of the interior of the wrought iron shell and the volume of potassic chlorate decomposed into oxygen and potassic chloride.

"II. The temperature of the shell at the moment of complete decomposition.

"III. The volume of the tube in which the condensation of oxygen is brought about.

"IV. The pressure before and after condensation.

"V. The pressures indicated by the manometer after two or three successive jets, till the moment the point of saturation is reached, and after which the gas issues in a gaseous form.

"These various data, combined with the gaseous density pressure and temperature, lead me to the conclusion that a difference of 74·26 atmospheres on the manometer represents the variation of pressure corresponding to the condensation of oxygen in the tube immersed in the carbonic acid.

"This variation has been exactly observed in the three last experiments which I have made with the assistance of many of my colleagues here at Geneva.

"The quantity of liquid oxygen which we had in the tube was 45·467 grammes, corresponding to a volume of 46·25 cubic centimeters. But it is possible that the highest part of the thin tube had some centimeters in length not occupied by the liquid. This may explain the difference of 0·8 gramme found.

"Moreover, very volatile liquids have such considerable expansions that it is indispensable to have exactly the temperature to which they are subjected, in order to determine their true density. However this may be, there is an absolute verification, within small limits of error, of the theoretical calculation regarding this physical constant."

In addition to this important result, in another experiment M. Pictet has used polarized light to determine the presence or absence of solid particles of oxygen in the jet. The jet was illuminated by means of the electric light, and observed with two Nicol prisms. A very strong polarization was observed, indicating the presence of solid particles, which in all probability were really solid particles of oxygen.—*Nature.*

OXIDATION OF IRON IN A GAS FURNACE.

By A. TERREIL and DAUBRÉE.

BARS of iron after exposure for some days to the action of heated carbonic oxide and carbonic acid gases in a furnace (Siemens') at the Paris gas works were found changed for about the depth of 7 millimeters into a black crystalline substance, which appeared on analysis to consist of ferrous oxide, together with magnetic oxide of iron. These bars form part of the regulating apparatus of the furnace, and they are oxidized constantly at about the rate of half a millimeter depth each day. A coating of terra-cotta several centimeters thick, with which they are covered, does not prevent the oxidizing action. These facts show how readily gases permeate solid bodies like terra-cotta and crystalline ferrous oxide, and they may throw some light on such geological phenomena as the metamorphic transformation of great thicknesses of solid rocks.—*Compt. Rend.*

OXYGENIZED GRAPHITE AND PLATINUM.

By WILLIAM SKEY.

GRAPHITE and platinum, after exposure to air, liberate iodine from a weak solution of potassium iodide in dilute sulphuric acid. This property is removed by ignition or by washing with alkaline solutions, and is restored by a short exposure to air, or contact with nascent hydrogen, or by treatment with dilute nitric acid. Such graphite or platinum transforms metallic mercury into mercurious chloride when voltaically paired with it. Charcoal, silver, and gold have the same properties, but in a much less marked degree. The author inclines to the view that the action is produced by absorbed oxygen ; it is also possible that nitric acid formed by the combination of this oxygen with the nitrogen of the air might produce the same effects, but this view is not so probable.—*Chem. News.*

IODINE AND ALCOHOL ON THE PLATINO-NITRITES.

By L. F. NILSON.

DURING his researches on the platino-nitrites, the author, by treating the potassium and barium salts with iodine, obtained interesting iodide derivatives.

As the solutions of the above salts had a very slow action on the iodine, 1 mol. of the latter in alcoholic solution was therefore allowed to act on 1 mol. of the platino-nitrite. After spontaneous evaporation, small black crystals separated out from the dark, reddish-brown solution, probably an additive product analogous to the bromide observed by Blomstrand. On heating this solution, a violent evolution of gas occurred at 30—40°, during which aldehyde could easily be recognized by its odor. The solution cleared, and settled finally to a clear and beautiful amber-yellow. The potassium salt crystallized to a small extent on the edges of the vessel, forming a solid, black deposit ; from this it was easy to free the iodo-derivative crystallizing also from the solution, as the latter is very soluble in a little cold water, leaving behind the black substance, and crystallizes readily from this solution. The *potassium salt* forms thus, after spontaneous evaporation of the solution, very large, four-sided, shining, amber-yellow prisms, stable in the air and losing water only when heated to 100°.

Analysis of the potassium salt led to the formula $K_2.N_2O_4.I_2.Pt + 2H_2O$.

The *barium salt*, $Ba.N_2O_4I_2.Pt + 4H_2O$, crystallizes in beautiful, shining, amber-yellow, oblique, four-sided columns. It dissolves easily in water, remains unaltered in the air, and loses at 100° a part of its water.

Silver salt.—From the solution of the salts described silver nitrate precipitates a completely amorphous compound, sparingly soluble in water, and of a lemon-yellow color. Washed with water, and spread on filter paper, it assumes a blood-red color, and the same change is observed after some time in its faintly yellow solution. This change of color depends probably on a molecular change, wherein silver iodide and some platino-nitrosic acids are formed, the latter compounds being distinguished by their characteristic red color. This silver salt, when gently heated, first gives off red and then violet vapors of nitrous acid and iodine respectively. The above salts were found to contain only half as much nitrogen as the platino-nitrites from which they are formed. The method of conversion is very remarkable. Doubtless the iodine simply adds itself to the platino-nitrite, and gives the iodide, $R_2.4NO_2.PtI_2$, wherein quadrivalent platinum is present. On raising the temperature, the alcohol takes part in the reaction. At 30—40° a change occurs ; the platinum again becomes bivalent, while the two groups NO_2 escape, oxidizing part of the alcohol to aldehyde, and forming ethyl nitrite with another portion, and are replaced by the two iodine atoms. The constitution of the platino-nitrite is then expressed as follows:—

$$\left.\begin{matrix} R{-}O{-}NO \\ R{-}O{-}NO \end{matrix}\right\rangle Pt,$$

and the iodine-compound will then be $\left.\begin{matrix} R{-}O{-}NO \\ R{-}O{-}NO \end{matrix}\right\rangle Pt$, a very interesting middle-member between platino-nitrites and iodo-platinites. The formation from platino-nitrites, iodine, and alcohol is thus expressed:—

$$K_2.4NO_2.Pt + I_2 + 3C_2H_6O = R_2.N_2O_4I_2.Pt + C_2H_4O + 2[C_2H_5.O.NO] + 2H_2O.$$

That aldehyde can be formed without separation of platinum shows with what great power the nitrogen and platinum are bound together. The radicle of the new salts is named *platino-di-iodo-dinitrosyl*, and the salts *platino-iodo-nitrites*. By double decomposition of the barium salt with sulphates, a whole series of these platino-isonitrites may doubtless be prepared, and with the investigation of these the author intends to proceed.—*Deut. Chem. Ges. Ber.*

DAVYUM.

By SERGIUS KERN.

THE weight of the davyum ingot used in the author's investigations was 0·27 gramme, which was dissolved in aqua regia. The following reactions were obtained with the solution of davyum chloride:—

Potash.—Light lemon-colored precipitate, easily soluble in acids, giving a brownish mass of davyum nitrate, on evaporating its solution in nitric acid. The latter gives davyum monoxide on ignition. *Prussiate of potash* (yellow).—Brownish precipitate. *Potassium cyanide* yields a solution giving on evaporation large prisms of cyanide of davyum and potassium. By passing hydrogen sulphide through a solution of the double salt, davyum-cyanic acid is obtained in the form of a crystalline red mass, which is decomposed even by a gentle heat. In acid davyum solutions hydrogen sulphide gives davyum sulphide, which dissolves in alkaline sulphides, probably yielding sulpho-salts.

From further experiments on the reaction of davyum chloride with soluble thiocyanates the author finds that the red coloration thereby produced is due to the davyum itself, and not to the presence of iron or any other metal.

Davyum chloride is very soluble in water, alcohol, and ether. The carefully crystallized salt attracts moisture very slowly when heated before the blowpipe. It yields the monoxide, which is soluble in aqua regia. The chloride yields double salts with chloride of potassium, thallium, and ammonium. These are insoluble in water, but easily soluble in alcohol. The sodium salt is nearly insoluble in water and alcohol, a fact which is very interesting, as most of the sodium double salts of the metals of the platinum groups are very soluble in water. The chloride above mentioned is the only stable compound of chlorine and davyum. Davyum sulphate is obtained by leaving davyum for two hours in contact with boiling sulphuric acid. It forms a yellowish-red salt, nearly insoluble in water. The specific gravity of metallic davyum is, as a mean, 9·389. Its atomic weight is not 100, as mentioned in a former paper, but near 154. The platinum ores do not contain more than 0·045 to 0·035 p. c. of davyum.—*Chem. News.*

A NEW GENERAL SYNTHETICAL METHOD OF PRODUCING HYDROCARBONS, ETC.

By C. FRIEDEL and J. M. CRAFTS.

WHEN to amyl chloride small quantities of anhydrous aluminium chloride are added, there occurs a brisk disengagement of hydrochloric acid gas, accompanied by hydrocarbons which are not absorbed by bromine. The liquid divides into two layers, and on the completion of the reaction one of these is found to contain an extremely varied series of hydrocarbons, ranging from highly volatile bodies to products having a boiling point above that of mercury. The lower members of the series belong to the hydrocarbons C_nH_{2n+2}, while the higher members are richer in carbon. When the above reaction was made to take place in presence of a hydrocarbon, it was easy to obtain a combination of the radicle of the organic chloride with the hydrocarbon, less the hydrogen replaced. Thus the authors mixed amyl chloride with a considerable excess of benzine, and having added aluminium chloride by small quantities at a time, they obtained, by fractional distillation of the products, a liquid boiling at 185—190°, and having the composition and properties of amyl-benzine, $C_6H_5.C_5H_{11}$. By using ethyl iodide instead of amyl chloride, ethyl-benzine was obtained, together with many compounds having a high boiling point. Similarly, by operating under proper conditions with benzine and methyl bromide or chloride, toluene and other higher derivatives of benzine were obtained. The other halogen salts of aluminium gave reactions analogous to those of the chloride.—*Compt. Rend.*

DETERMINING VAPOR-DENSITIES.

By J. HÄBERMANN.

THE author applies to the process of Dumas the same modification that was applied by Hofmann to Gay-Lussac's process ; that is, he determines vapor-densities under reduced pressure. This is effected by connecting the flask containing the substance of which the vapor-density is to be determined with a water-pump furnished with a manometer, and exhausting to a pressure of about 500 mm. of mercury, while the flask is heated in an oil-bath to near the boiling point of the substance. The advantages claimed for the modified process are that a vapor-density can be determined with less than 1 gramme of substance, most of which is recoverable afterward, and that the temperature need never exceed the boiling point of the substance. The paper gives details of manipulation, with a drawing of the apparatus, and several examples showing that the process works well.—*Liebig's Annalen.*

SPECIFIC GRAVITY OF IODINE TRICHLORIDE.

By A. C. CHRISTOMANOS.

THE process in principle is as follows :—At a low temperature iodine trichloride remains unaltered in atmospheres of chlorine or of carbon dioxide. A glass vessel closed by glass taps is therefore filled with chlorine, and the weight of the vessel full of chlorine is taken. The chlorine is now driven out of the vessel by a stream of carbon dioxide, and the vessel is weighed again. The pure iodine trichloride is now introduced into the glass vessel, chlorine again passed through, and the vessel again weighed. The increase of the present weight is equal to that of the iodine trichloride less that of the portion of chlorine gas of equal bulk displaced by it. The weight of this volume of chlorine must now be found, in order to deduce from it directly the volume of the iodine trichloride, and indirectly its weight. The quotient from the two numbers gives the desired specific gravity. The chlorine gas over the iodine trichloride is then displaced by carbon dioxide in the cold, and the apparatus is again weighed. From this number the weight of the iodine trichloride is reckoned, less the weight of the equal bulk of carbon dioxide displaced. This volume of carbon dioxide is equal to that of the chlorine, and from the known specific gravity of these two gases a certain numerical relation may be deduced. By substituting this the weight of the quantity of chlorine is obtained, and consequently its volume, and next the weight of an equal volume of water ; lastly, the absolute weight of the iodine trichloride is deduced, and this without its being either actually weighed or measured.—*Deut. Chem. Ges. Ber.*

PADS.

By P. TOWSEND AUSTEN.

FELT pads are recommended to be placed under flasks and beakers, so as to prevent cracking by sudden cooling when placed on the laboratory table, and to avoid scratching by pieces of grit.

Microscopic Crystals.—Microscopic crystals may easily be obtained by placing on a warm watch glass a drop of the concentrated solution contained in a second watch glass, a thin film being thus obtained. The upper glass should not be pressed, but allowed to rest of itself. The drop thus expands into a film ; and if a few drops of ether be placed in the upper watch glass, the cold resulting from its evaporation will cause crystallization to take place between the two glasses.—*Chem. News.*

SOLUBILITY OF ALKALIS IN ETHER.

By WILLIAM SKEY.

THE alkalis dissolve in hydrous ether, as do also lime and magnesia. The alkalis and their carbonates appear, also, to dissolve in anhydrous ether, which likewise dissolves a notable quantity of the chlorides of calcium, nickel, zinc, cadmium, and platinum, as well as the thiocyanates of nickel, copper, and zinc : a small quantity of water added renders the ether turbid, due to the precipitation of these salts.—*Chem. News.*

LITHIUM, CÆSIUM, AND RUBIDIUM FROM LEPIDOLITE.

By H. PETERSON.

THE mineral is strongly heated and thrown into cold water. The resulting powder is heated for a considerable time with sulphuric acid of 66° Beaumé ; the filtered liquor is allowed to deposit crystals of cæsium and rubidium alum ; the mother-liquor is treated with potash ; the potassium alum is removed ; and lithium is precipitated as carbonate by addition of sodium carbonate. The lithium carbonate is purified by causticizing with lime, and the hydrate is reconverted into carbonate, which is now pure. The residue left after the first treatment with sulphuric acid may be utilized for the manufacture of alum.—*Dingl. Polyt. J.*

MAGNESIUM FLUORIDE.

By A. COSSA.

ALMOST the only notice about magnesium fluoride since the time of Berzelius is the discovery by Struever of a native crystalline magnesium fluoride, named *sellaite*, near Moutiers, in Savoy. This induced the author to endeavor to prepare anhydrous magnesium fluoride artificially. On adding a solution of an alkaline fluoride to one of magnesium sulphate, an amorphous gelatinous precipitate of magnesium fluoride is obtained which is difficult to wash. A better process is to treat pure magnesia with pure hydrofluoric acid, and remove the excess of the latter by heating the product to 100°. All attempts, however, to prepare the fluoride in the crystalline state directly, failed ; but on strongly heating the amorphous fluoride obtained by the processes just mentioned, it fuses completely, and on cooling solidifies to a crystalline mass. Magnesium fluoride crystallized in plates was obtained by fusing a mixture of the amorphous fluoride with an alkaline chloride, and removing the latter by treatment with water when the mixture had become cold. The crystals obtained in this manner are twin, and when examined by polarized light exhibit the same characters as those from the fused magnesium chloride. They have been measured by Struever, who pronounces them to be identical with the native fluoride, sellaite. The crystals have a density of 2·856 at 12°, and their hardness is 6. After being submitted to the influence of an electric current from a Ruhmkorff's coil for a short time, and then gently heated, they become fluorescent in the same way that fluor-spar does, emitting a violet light. Sellaite itself exhibits a similar property, as do also other crystalline fluorides ; but neither calcium nor magnesium fluoride in the amorphous state is capable of being rendered fluorescent.

Crystalline magnesium fluoride melts at a very high temperature. It is insoluble in acids with exception of concentrated sulphuric acid, which readily decomposes it. With calcium, barium, and strontium sulphates it forms readily fusible compounds of definite composition. Heated with aluminium sulphate, it yields aluminium fluoride.—*Gazzetta Chimica Italiana.*

NATURAL SULPHIDES.

By STAN. MEUNIER.

MANY natural sulphides, such as galena, iron pyrites, copper pyrites, blende, cinnabar, antimony sulphide, and even sodium monosulphide, when placed in the solid state in solutions of gold chloride, mercury chloride, or silver nitrate, determine the reduction of the metal. The reaction is as follows :—

$$3PbS + 2AuCl_3 = 3PbCl_2 + Au_2 + S_3$$
$$PbS + 2AgNO_3 = Pb(NO_3)_2 + Ag_2 + S$$

These facts may perhaps be capable of explaining the mineralogical associations so frequently met with in metalliferous veins.

Sea-water, according to Malaguti and Durocher, always contains silver. If this water were to pass by infiltration along a vein of galena, the whole of the silver would be precipitated and concentrated by the sulphide. It is known that native silver exists in many galenas, and it is reasonable to imagine that it may have been introduced in the manner above stated ; moreover, the silver being in fine division, and under circumstances favorable for sulphuration, is very likely to pass subsequently to the state of sulphide, and, uniting with the original lead sulphide, would give rise to what is known as argentiferous galena.

Again, since the precipitation of the metal is accompanied by the liberation of sulphur, this may account for the existence of galenas containing an excess of sulphur ; in the majority of cases, however, this sulphur would probably not remain long uncombined, but would either unite with the precipitated metal or pass away by some process of oxidation. The association of gold with pyrites may be explained by the action of the same or similar influences.—*Compt. Rend.*

MANGANESE SULPHIDE.

By Ph. de Clermont.

When flesh-colored manganese sulphide is heated either alone or with water to 250°, it remains unaltered, but when the temperature is raised to 305° in presence of a small quantity of water, the color of the sulphide is changed to green. The pink sulphide becomes green when heated in sealed tubes to 220° with ammonia, with hydrogen sulphide, or with a mixture of potassium and ammonium sulphydrates; but with potassium sulphydrate alone under similar conditions the color changes to violet.

By boiling manganese carbonate with ammonium sulphydrate, or by heating them together in closed tubes to 200°, the green sulphide is produced. If potassium sulphydrate is substituted for the ammonium salt, the pink sulphide only is obtained. The color of the pink sulphide is also changed by heating it in a current of dry ammonia or carbonic anhydride.

It has been stated that the green sulphide is in reality an oxysulphide of manganese; the author's experiments, however, show that the alteration in color is not attended with absorption of oxygen, and, further, that while the weight of the green compound when dried at 105°, first in a current of hydrogen and afterward in hydrogen sulphide, remains constant, the weight of the pink sulphide when similarly treated is diminished by 9 per cent. The author, therefore, regards the former compound as the anhydrous and the latter as the hydrated sulphide. The relative solubility of the two sulphides in ammoniacal salts points to the same conclusion; nevertheless, all attempts to produce the rose colored from the green sulphide by direct hydration were unsuccessful.—*Compt. Rend.*

RETARDING ACTION OF GLYCERINE.

By Dunn.

The action of a glycerine solution of iodine on iron was tried. Four cylinders were taken, and into each was put 25 c.c. of a solution of iodine in iodide of potassium. They were then made up to 50 c.c., two with water and two with glycerine. A piece of iron wire was then placed in each; in two the iron wire was suspended near the surface of the fluid, and in the others it was placed at the bottom.

The water solutions were found, after a week, to have been acted on much more rapidly than the glycerine solutions, the difference being most marked in the case of those in which the wire was at the surface. In all the cylinders, however, the wire became covered with bubbles of gas, so that the protective action of the film of gas is not eliminated by using iodine. By using bromine instead of iodine, the iron was rapidly attacked in the water cylinders, but the action in the glycerine solution appeared to be complicated by other reactions; the bromine in one cylinder was completely decolorized save at the bottom, and in the other the color was paler than originally. In this case, also, bubbles of gas were observed, larger and fewer in the water solutions than in the glycerine solutions.—*Chem. News.*

CRYSTALLIZED GRAPE-SUGAR.

By Halse and Steiner.

In 1875, a cargo of starch-sugar was returned from Australia and offered for sale in England, when it was found to be partially crystallized and to resemble cane-sugar, and it actually was taken as such. The authors for this reason obtained samples, which were analyzed. The samples were of three different sorts—amorphous, amorphous with superficial crystallization, and others completely crystallized. The amorphous substance, similar to starch-sugar, is grayish-white with stripes of brown passing through it. It feels dry, is hard, and slightly hygroscopical. The second sample consisted of amorphous dark-brown lumps of a very pasty nature, with completely developed crystalline groups (rosettes) imbedded in them, and a yellow, very well crystallized thin crust on some parts of the surface. The rosettes are of the size of a bean up to that of a chestnut, and have a clear amber or pale-yellow color, with a fatty glance. To free the rosettes from the adhering amorphous substance, they were first immersed in dilute alcohol, then dipped in absolute alcohol, and subsequently dried with filter paper. The third kind of sample was in completely crystallized compact pieces, remaining dry in the air, and being very hard. By treatment with alcohol, a part of the mass was dissolved out and a network of the larger warty crystals of an amber-yellow color was obtained, while the pieces of the very fine crystallization were of very much darker color, and soluble in alcohol. The following are the results of the analyses:—

CRYSTALS.

	Rosettes.	Nodules of the size of a bean.	Nodules smaller.	$C_6H_{12}O_6 + H_2O$ corresponding to.
Ash.....	trace	trace	trace	—
Water...	9·45	9·26	9·45	9·09
Glucose..	90·35	90·45	90·20	90·91
Dextrine.	0·20	0·29	0·35	—
	100·00	100·00	100·00	100·00

SAMPLES.

	Amorph. with rosettes.	Amorph. without rosettes.	Fine crystallized.	Warty, small.	Warty, larger.	Amorphous.
Ash.....	0·36	0·37	0·33	0·29	0·15	0·45
Water	12·00	12·20	11·80	11·20	10·50	8·60
Glucose....	80·10	78·60	81·40	84·60	85·00	83·90
Dextrine...	1·74	1·90	1·53	0·79	0·68	1·54
Optic inact. subst....	5·80	6·93	4·94	3·12	3·67	5·51
	100·00	100·00	100·00	100·00	100·00	100·00

In considering the results of the analyses of the samples with the warty crystals, the author mentions that only an increase of sugar takes place with the growth of the crystallization, and it may also be assumed that if the adherent amorphous mass could be completely separated from the crystals, the latter would represent pure grape-sugar. The darkening of the amorphous mass may have been effected by the combined action, on partly caramelized products, of moisture, lime, and of the ammonia liberated by the putrefaction of the albuminous matter (gluten) present. A long voyage in a tropical climate furnished not only the necessary conditions for the melting of the substance and for the development of ammonia, but was also favorable to such a slow crystallization as grape-sugar requires. Once the crystallization introduced, a continual growth took place.—*Chem. News.*

DEPOSIT OF FAT IN ANIMALS ON DIFFERENT DIETS.

By J. Forster.

Having premised that in an animal two causes operate in producing a reserve of fat, viz. (1), the accumulation of the fat of the nourishment which reaches the organism in excess and (2), the formation of fat from albumen in the body, and its accumulation there in consequence of the consumption of an abundance of carbo-hydrates, the author contends that in the former case an accumulation of fat should occur in the so-called fat-tissues (subcutaneous cellular-tissue, mesentery, etc.), whereas in the latter, seeing that the formation of fat must be supposed to take place in the cells of the different organs, the fat-deposit should occur in those organs (liver, muscles, etc.) in proportion to the amount of the metamorphosis of albumen taking place in them.

To ascertain whether this difference takes place the author experimented with three pigeons, feeding them all three for six days on 5—6 grammes of horse-meat, dried, powdered, and deprived of fat, together with water. The birds having lost much fat, one (A) was killed, and the amount of fat in the different parts of the body estimated. The second pigeon (B) was then fed on fat with a trace of meat-powder, and killed after three days. The third pigeon (C) was at the same time fed on two parts of the meat-powder and two and a half parts of starch for nine days, and then killed. An estimation of the fat in the different organs gave the following results:—Both the absolute as well as the relative content of fat was much increased in pigeons B and C. The insufficiently fed pigeon (A) contained more water in all the organs than the other two. This is a well known fact. No increase of fat had taken place in the livers of pigeons B and C. With regard to the position of the fat, the author concludes that there is *no* noticeable difference, whether the fat is derived from without or is formed within the animal body: both varieties of fat, at least at the commencement of fattening, become equally deposited, and in the case of the pigeon the deposit takes place principally in the subcutaneous connective tissue. This accumulation of fat at a distance from the point of its formation the author considers an additional proof of its ready passage through animal cells and membranes.—*Zeitschr. für Biologie.*

OPTICALLY INACTIVE SUGAR.

By W. E. Halse and E. Steiner.

A sample of molasses, the drainings of molasses into a ship's hold, and consequently mixed with bilge-water, had the following composition: organic mater, 42·50 p. c.; water, 51·75 p. c.; ash, 5·75 p. c. After clarification with subacetate of lead, it reduced copper solution to an amount equal to 27·70 p. c. of glucose. It was optically inactive. To decide whether it was a mixture of levulose with dextrose or saccharose, it was partially fermented, and even then remained without action on polarized light. Even after treatment with caustic soda to destroy levulose, it remained inactive. The only possible conclusion accordingly is that the sugar was an inactive modification.—*Chem. News.*

ESTIMATING BISMUTH VOLUMETRICALLY.

By M. M. P. Muir.

I have convinced myself that, from a solution of bismuth in nitric acid made nearly neutral with ammonia, *or mixed with an excess of sodium acetate*, the *whole* of the bismuth is thrown down on boiling for a few minutes with an excess of sodium phosphate; that the relation between bismuth and phosphoric acid in the precipitate remains perfectly constant during ebullition, independently of the amount of nitric acid originally present, provided that amount be sufficient to maintain the whole of the bismuth in solution, and provided that an excess of sodium acetate be added before the addition of sodium phosphate; and lastly, that the relation between bismuth and phosphoric acid in the precipitate is as Bi : PO_4, or that P_2O_5 precipitates 2Bi.

MAINTENANCE OF CONSTANT TEMPERATURES.

By A. D'Arsonval.

The author's improvement consists in arranging two conical vessels concentrically, the inner one constituting the bath, which it is desired to maintain at a constant temperature. The space between them is completely filled with water, and is so arranged that as the water expands on heating, it presses against a caoutchouc membrane, which, being in connection with the gas supply, regulates the passage of the latter to the burner. By this arrangement sources of error are eliminated, while the sensibility of the apparatus increases with its size. For a bath holding 20 liters of water, the expansion is about 3 to 4 c.c. for one degree; since $\frac{1}{10}$ c.c. suffices to regulate the supply, the temperature of the bath can be kept constant within $\frac{1}{100}$th of a degree.

Albumen in Serum and in Milk.—To determine albumen in serum the author acidulates the acetic acid and adds alcohol till the mixture contains 70 per cent. of the latter. He boils and washes the precipitate first with alcohol at 70 per cent. and then with absolute alcohol. The precipitate is dried, weighed, incinerated, and the weight of the ash is deducted from the weight of the dry matter. The alcoholic filtrate is free from albumen. The author has found in seven experiments quantities of albumen varying from 7·92 to 7·99 per cent. In cows' milk he has found 3·40 to 3·43 of albumen, and has ascertained that milk-sugar is soluble in alcohol, and therefore does not affect the results. Woman's milk contains 0·95 per cent of albumen.—J. Puls, *in Pflüger's Archiv.*

THE MORBID ANATOMY OF YELLOW FEVER.

Some recent researches into the morbid anatomy and histology of yellow fever by French observers serve to confirm and extend other observations by the light of modern methods. They do not, however, throw much light upon the nature and causes of the disease. Dr. Crevaux, of the French Naval Medical Service, has studied the histology of the organs during an epidemic which occurred in April and May of the present year in the Salutation Islands. In the respiratory organs he observed congestion of the lungs, and occasionally pulmonary apoplexy, with, more rarely, some pneumonic exudation. In the heart he found superficial punctiform hemorrhage in two-thirds of the cases, but fatty degeneration and softening, described by some observers, were usually absent. The blood presented no special morbid change. In the digestive organs there was almost invariably a superficial or catarrhal stomatitis, chiefly marked along the gums, which led not unfrequently to ulceration and hemorrhage during the second stage of the fever. The whole of the gastro-intestinal mucous tract was the seat of patches of congestion, ecchymoses, and sometimes ulceration, which were most marked in the stomach and lower part of the ileum, the glands of the latter being often swollen, but rarely ulcerated. Examination of the mucous membrane of the stomach showed fatty degeneration of the capillaries and of the epithelial cells lining the gastric glands, the cloudy swelling of the epithelium giving a semi-opaque swollen appearance to the mucous membrane. The liver was usually swollen, yellow, and fatty; on section dry and bloodless, with the exception of some cases in which there was evident congestion, with ecchymoses, which were most abundant near the surface. The changes seen with the microscope consisted in congestion of the portal venules with occasional exudation around them, granular and fatty degeneration, and breaking up of the cells. The gall-bladder usually contained dark thick bile. The spleen was of normal volume and consistence in thirty-six out of forty-one cases, and the enlargement observed in the remainder was evidently of old date, and due to preceding malarial fever. The most marked changes were found in the kidneys, which were diseased in all the forty-one cases. In the early stages the disease consisted in extreme hyperæmia, with ecchymoses on the surface, in the cortex, and in the submucous tissue of the calyces and pelvis. The latter condition Dr. Crevaux believes he is the first to point out, but it was long ago observed by Pennell. It occurs in more than half of the cases. Ecchymoses in the cortex were more frequent, and Dr. Crevaux was able to prove that they took place from the Malpighian tufts, showing that they were probably due to intense hyperæmia and capillary rupture. In the later stages changes were found in the epithelium of the convoluted tubules, analogous to those in acute Bright's disease. Dr. Crevaux concludes that the changes which occur are chiefly in the stomach, liver, and kidneys; that they consist at first in congestion, and later in fatty degeneration. Dr. Lebredo, of Havana, in a recent note to the Société de Biologie of Paris, has communicated the results of a minute microscopic examination of the liver from two cases. He found in both some of the changes characteristic of the form of cirrhosis described by Charcot and Gombault, and now known as "biliary cirrhosis;" but these could not have been due to an acute disease. He found also exudation of leucocytes in the portal spaces, and a general atrophy of the hepatic cells, with a vesicular state of their nuclei; in some parts also a very marked fatty degeneration of the cells. Dr. Lebredo proposes to carry out more extensive histological researches in Cuba.

It will be seen that while the changes described by these observers correspond in the main with those previously observed by Bache, De la Roche, Griesinger, Charcot, and others in yellow fever, they differ but little from those seen in other fevers, where they assume a malignant type. One point of interest is the confirmation of the fact that the spleen is but little altered in yellow fever—a fact which, though clearly established by all observers, needs explanation, and is not satisfactorily accounted for by the relief of congestion produced by hemorrhage from the stomach. If this be the sole cause of absence of enlargement, there may yet be changes in the organ which do not reveal themselves to the naked eye. But the minute changes which may throw any light on the pathology and etiology of yellow fever are yet to be discovered.—*The Lancet.*

PHYSICAL DILATATION OF THE URETHRA.

In the *Bulletin de Thérapeutique* of September 30, Dr. Berenger-Féraud recurs to this mode of treating stricture, which he had already advocated on former occasions. Originally devised by Brunnighausen in 1794, it fell into disuse after some successes had been obtained. Dr. Berenger-Féraud has persevered in giving it a full trial, and regards it, in suitable cases, as a valuable procedure. It consists in compression being exerted just behind the glans by the patient each time just before he passes urine, so that none issues until the canal has undergone dilatation by its presence in it. The practice is to be perseveringly repeated, and then, as numerous cases show, may prove very efficacious. From the trials that have been made it results—1. That dilatation so produced, performed after a gonorrhea of some duration, may act as a prophylactic of stricture. 2. In stricture that has not advanced very far, if it do not restore the caliber of the urethra to its normal dimensions, it does so sufficiently to render micturition easy. 3. After urethrotomy it is a useful means, if not for preventing, at least for retarding, the return of the stricture. 4. It may prove of some service in varices of the prostate, neck of the bladder, and membranous part of the urethra. 5. Another class of cases benefited arises when the course of the urethra more or less deviates from its normal direction, in consequence of enlarged prostate in aged persons. The small quantity first ejected from the bladder, if retained a while in the urethra by compression, greatly facilitates the evacuation of the remainder.

DISSECTION OF A GORILLA.

The body of the Berlin gorilla Pongo has been carefully dissected by Profs. Virchow and Hartmann. The cause of death was found to be acute peritonitis. Pins, iron wire, and a button-glove were found in the stomach.

TREATMENT OF DIABETES MELLITUS WITH SALICYLATE OF SODA.

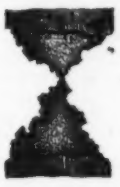
Ryba and Plumert have arrived at the following results: 1. Salicylate of soda, given in daily doses of eight grammes, determined a decided diminution of saccharine excretion. 2. Considerable differences are observed, according to the severity of the case. In recent cases the sugar can be made to disappear completely, and does not reappear immediately after the remedy is stopped. In cases of longer duration the effectiveness of the remedy is also apparent, though the sugar does not disappear entirely, nor is there a favorable after-effect. Lastly, in cases of several years' duration, with severe diabetic symptoms, no result was attained by treatment, at least not from the small doses administered. 3. The diminution of saccharine production is more remarkable by the greatest restriction of hydrocarbons in the diet. 4. Diminution of the quantity of urine is parallel with the diminution of sugar; but in one case the polyuria remained in spite of the considerable diminution of saccharine excretion. Other diabetic symptons and the bodily weight are also favorably influenced. 5. In two cases the quantity of both urine and sugar was increased for a short time after

the commencement of medication, followed, however, by progressive diminution. Treatment by salicylate of soda is followed by a greater diminution of sugar excreted than when the treatment is indifferent.—*Prager Med. Wochenschrift, Med.-Chir. Centralblatt.*

THE LIMNORIA AND THE TEREDO.

AN IMPROVED METHOD OF PROTECTION AGAINST THEIR RAVAGES IN TIMBER.

THE *Limnoria terebrans* is a crustacea of the *Isopoda* order. The *limnoria* is about two lines in length, or about the size of a grain of rice, and of a dark ash-gray color. The front outline of the body is a long oval, though the head is large, round, and strongly defined. The eyes are black, and are composed of numerous ascelli placed close together. The general appearance is like that of a wood louse. When



A PILE EATEN OFF BY LIMNORIA.

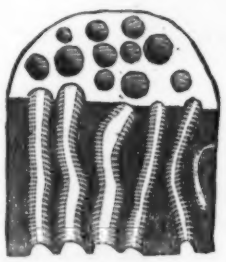
KNOTS LEFT BY LIMNORIA.

disturbed or handled they roll themselves up like a hedgehog. These little creatures are wonderfully destructive to submerged timber, such as piles, docks, piers, bulkheads, etc. In the Bay of San Francisco they eat piles off entirely in a short time. The contents of the stomach consist of comminuted wood, showing that food is the object sought. They attack a pile about half tide. The *limnoria* swarm around the timbers attacked in great numbers. They excavate little cells along the annual rings of growth, and while eating the wood for its albumen, as is presumed, make a sheltering place for protection from enemies, and in which to breed. The outside of the wood has a spongy look, and is very frail. A mass of these perforations as large as a base ball taken into the hand and the water squeezed out leaves a mere pulp of woody fiber many times reduced from its original bulk.

The illustrations show this timber-boring shrimp enlarged seven times. Another engraving shows the appearance of a pile eaten off by *limnoria*, and another shows how they leave the knots in their work.

Mr. John P. Culver, an engineer of this city, has been investigating the habits of these creatures, and also the *Teredo navalis*, and has devised a plan to prevent their ravages, which we describe below.

The *teredo* bores lengthwise, the grain of wood following the rings of annual growth. As long as any wood remains to be eaten between the stages of water where they work,



SECTION OF PILE EATEN BY TEREDO.

which is usually between low tide and the mud line, they continue completely riddling the wood. In the harbor of San Francisco they are very destructive, as well as along the coast.

The *Limnoria terebrans* eats lengthwise and crosswise the wood both. The *teredo* and *limnoria* together make a combination which heretofore has been omnipotent, so that when they once started in on a pile, there was no chance for it.

The process invented by Mr. Culver to prevent these ravages consists in treating the piles, with the bark on or off, as follows:

First, there is a poisonous composition brushed over the surface of the pile or timber, which is allowed to dry; then the pile or timber is coated with asphaltum, laid on at great heat to the bare wood, after which burlaps, treated in asphaltum, are wound around in spiral courses while warm, and finished by a final coating of hot asphalt. The piles can be handled, transported and driven without injury to the coating.

The pile is first covered with the poisonous composition over the surface, which is shown as darkly shaded in the engraving. The pile is then wound with spiral courses of treated bagging over the same part, and then given a final coat of asphalt finishing, and is ready to drive.

The cloth or fibrous material being thoroughly saturated with hot asphalt, and protected, will not decay, and forms

LIMNORIA TEREBRANS.

at the same time a cheap non-corrosive, indestructible, elastic covering, closely adherent and bonded to the wood or bark on the outside of the pile, and held there by the spiral-wound fibrous bagging.

Two destructive elements have to be considered in protecting piles in salt water: First, the *teredo* and boring shrimp below the tide lines; second, the natural decay of the wood above the tide lines. By protecting the pile below tide lines with the patent covering or shell, the work of the worm and shrimp is effectually stayed. The cost of preparing a pile in this way is $3.50, and other timber work in proportion. There are some piles in Battery street wharf treated by this process, which have been down nearly a year, and we are informed that they have not been attacked yet by either the *limnoria* or *teredo*. Piles treated this way have been in New York harbor for three years, and the *teredo* has not attacked them.—*Mining and Scientific Press.*

HEN MANURE.

EVERY experiment properly made with the sweepings of the poultry house shows their great strength and value, analyses indicating the same. Hence the importance of securing all that may be had of this rich manure and preparing it for application to land. The mode which we have adopted is simple and easy. A number of coarse barrels are procured, a part of which are filled with road-dust (the dryer the better) during the dry season of the year, and placed under shelter. A layer of an inch or two of this is first placed in the bottom of a barrel, and a layer of sweepings of the poultry house is spread on it. Another layer of road dust is added, and again the hen manure, and so on alternately till the barrel is filled. It is then rolled aside and another filled in the same way. The proportion of road-dust to the droppings will depend somewhat on the character of the dust. If it is composed largely of clay, less will be necessary as an absorbent than if largely of sand. Dust made from medium loam should be about double the bulk of the hen dung; if quite sandy, three or four times as much should be used; if strong clay, one and a half will do. The thinner the alternating layers, the more perfect will be the intermixture, and the more completely the absorbent will act on the manure.

If the hen dung should be dry enough to be pounded up or pulverized before placing in the barrels, the thinner the layers may be made, and the more perfect the compost will be, and ready for application to the land; but this is not always the case, and it will therefore be necessary to pulverize the mixture well in spring before using it—both for the purpose of readily and evenly spreading, and for its perfect intermixture with the soil and action on the plant.

If road-dust has not been secured at the right time of the year, a good substitute is coal ashes (but not wood ashes), which however must be used in larger proportion. Where coal is not burned and the collection of road-dust has been neglected, loam dug from beneath the frozen crust of the ground will answer tolerably well if dry enough to be well pulverized, although the water it contains is a strong objection, as the composted mass adheres together, and requires some labor in spring to pulverize it. It would be better to procure leaf mould from the woods, where it may be had at any time during winter unfrozen, if sought for in hollows, where it has most largely accumulated, and where the leaves blowing on in thick masses prevent freezing. A mixture of this leaf mould with coal ashes, by applying them in alternating layers in the barrels, forms an excellent compost.

Every farmer whose hens roost at night in a poultry house will be able each year to fill several barrels with this powerful fertilizer, even if his hens run at large during the day; and when the fowls are confined constantly and fed grain, a larger quantity may be secured, When they are fed largely or mostly on grain and flesh, the manure will be more valuable than when during the summer season they live mostly on green vegetable substances.

In this connection, and as showing the value of this manure, we cite some of the experiments reported at a late meeting of the Elmira Farmers' Club, in one instance of which a single handful of the compost (which had only one-third hen dung) dropped in each hill increased the product more than fifty per cent. The yield per acre was not given, but supposing it to be a medium crop of 40 bushels per acre when no manure was applied, the hen manure would run it up to more than 60 bushels, or it would make an addition of 20 bushels for this crop alone, to say nothing of what should come after. If each hill of corn received one gill of hen manure (which is doubtless more than the actual quantity), the whole amount per acre would be ten bushels, and the experiment would indicate that every bushel of hen manure added two bushels of corn to the product, besides the increase in the fodder, and in the crops which were to follow.

Among other experiments mentioned at the above-named meeting was the use of pulverized hen-droppings without any mixture, dropped in the hill and the seed placed upon it. A part of the seed was destroyed by the corrosive character of the manure, and the rest sprouted feebly. The best result was obtained where the hen manure was covered with earth, and the seed put in with a hand-planter below the manure. This was especially well fitted to harrowing the corn broadcast. When the unmixed manure was placed in the hills of cucumbers and melons, it destroyed all.—*Country Gentleman.*

GOLD IN EMULSION.

By HENRY J. NEWTON.

REFERRING to the increased sensitiveness obtained by the addition of gold, Mr. Newton says:

The gold I used was the commercial article, and the solution decidedly acid. I found that chloride of platinum produced increased sensitiveness if used quite acid, when the opposite effect was the result if used alkaline. I have never tried the gold in an alkaline condition, and am, therefore, unable to say whether the effect under this condition is the same as with chloride of platinum.

With emulsion as I construct it, and the gold used as I use it, I should think there could be very little chance for any material variation in results. It has been quite thoroughly tested by some of our best and most practical workers here, and with uniform results in its favor, in increasing the sensitiveness at least one-third.

Formula for Collodion.

Alcohol	2½	ounces.
Ether	6	"
Wood naphtha	1½	"
Cotton	8	grs. to the oz.
Bromide of cadmium	12	"

To make the emulsion, add eighteen grains of fused nitrate of silver to the ounce in boiling alcohol. This gives three grains of silver in excess. When the excess of silver has acted upon the organic matter of the collodion for about eight hours it is converted into a chloride with hydrochloric acid. It reaches its maximum point of sensitiveness in ten or twelve hours, and usually enters the foggy condition in that time, and it requires a week or more to work clear after adding the acid, if left that length of time. The free silver can be permitted to act longer on the collodion when hydrochloric acid is used to convert it into a chloride than when the chloride of cobalt or calcium is used

I determine the strength of my hydrochloric acid by dissolving ten grains of nitrate of silver in half an ounce of water, and, with a dropping-tube which I never use for any other purpose, drop in the acid until the silver is all converted into a chloride. After having determined the number of drops required to convert ten grains of silver nitrate into a chloride, I keep this sample of acid for this particular use.

This is necessary from the fact that hydrochloric acid varies somewhat in the volume of chlorine which it contains. I usually add a few drops more than necessary to convert all the silver. To make sure that all the free silver has been removed, I flow some of the emulsion on clean glass and expose to the light for a short time, and then apply some of the ordinary iron developer. If any free silver remains it will discolor under the action of the iron, and acid should be added until no change is produced by the combined action of light and the iron developer.

Emulsion made in this way should work clear the next day after compounding, but will improve for a week, and will be found to change very little in a year. The sensitiveness can be increased by increasing the quantity of silver. Twenty grains instead of eighteen will add to its sensitiveness. I should prefer in this experiment to have the formula as given strictly adhered to. The use of the wood naphtha makes the solution of the cotton more complete, and therefore a more even-flowing emulsion.

This emulsion cannot be used successfully with a strong preservative. The preservative to be used is compounded as follows:

Water	12	ounces.
Syrup of squills	1	drachm.
Tincture of nux vomica	1	"
Laudanum	1	"

Let this stand twenty-four hours, and filter. This preservative can be used for months. It is not absolutely necessary to let it stand twenty-four hours, as it will give good results immediately after compounding, but I think it gives better after a little age.

Plates prepared with this emulsion should not be washed before immersing in this preservative, but should be put into it as soon as sufficiently set, and when the greasy lines are washed off they are ready to be removed, and can be set away to dry or can be used wet. In my experiments I always use them wet; they are, however, more sensitive when dry.

To develop, make a solution of—

Concentrated ammonia	½	ounce.
Water	½	"
Bromide of ammonia	10	grains.

This is stock-bottle No. 1. When ready to develop, dissolve in one ounce of water from two to six grains of pyrogallic acid; it is not very material about the strength of the pyro-solution, but it must be in water, as the alcoholic solution will not give satisfactory results with this mode of developing plates prepared with this emulsion.

After the plate has been exposed and washed under the tap, flow it with sufficient of the pyro-solution to cover it well; flow off and on until the outlines of the image appear; then pour the pyro into a vial containing six or eight drops of solution No. 1, and reflow the plate, when the required intensity will immediately be attained.

Two drops of a solution of chloride of gold, eight grains to one ounce of water in eight ounces of emulsion, makes a marked difference of sensitiveness.

My first experiments with the gold solution on emulsion plates were made as follows: After flowing a plate with emulsion, I washed it with clean water, and flowed one-half of it with water containing a few drops of the gold solution, then exposed and developed.

If the dry plate worker will treat a plate in this way, and use for the purpose—

Water	12 ounces
Gold solution	1 drop,

he will soon discover the potency of the chloride of gold on an emulsion film. If he will add one grain of the iodide of potassium to twelve ounces of water, he will find that this small quantity of iodide also has a marked effect. The quantity of gold can be increased a drop at a time, until that part of the plate treated with it will turn blue under the action of the light in the camera, before the rest of the plate is exposed sufficiently to show but the faintest trace of an image under the developer.

This emulsion can be developed with the carbonate of soda and pyrogallic acid; I do not mean bicarbonate, but what is commercially known as sal-soda. It can be used very strong, with bromide of ammonia as a restrainer. I have used between eighty and ninety grains to the ounce of water; that was just before saturation. About sixty grains to the ounce gave very satisfactory results.

Some time since the *British Journal* published a formula for strengthening emulsion plates with chloride of copper and alkaline pyro. Afterward Mr. M. Cary Lea published in the same journal a similar formula, substituting, however, the chloride of gold for the chloride of copper. I have used the chloride of mercury in this formula with more satisfactory results than with either of the first-named chlorides.

There is still another formula which I think would give more general satisfaction on account of the rich color it gives to the negative, which is the mixing of the chloride of gold and chloride of mercury in the proportion of one grain of gold to four of mercury. I prefer, however, the iron redeveloper which I published some time since, as it is more under control, and the results are in every way satisfactory.

In a number of the *British Journal* there is an article on the removing of hyposulphite of soda from prints. The process alluded to is one published by me several years since, and appears to have been successfully used by a Mr. Viles. I have since on several occasions published an improvement on the process as first given.

When the solution of lead is added to the water to receive the prints it becomes milky by the formation of the carbonate of lead. If the prints are put into the solution in this condition the carbonate adheres to the albumen surface, and is not easily removed.

This carbonate of lead is readily soluble in acetic acid; therefore a sufficient quantity should be added to the water after the lead, and the mixture agitated until it becomes clear; then it is ready for the prints.—*Photographic Times.*

SCIENTIFIC AMERICAN CHESS RECORD.

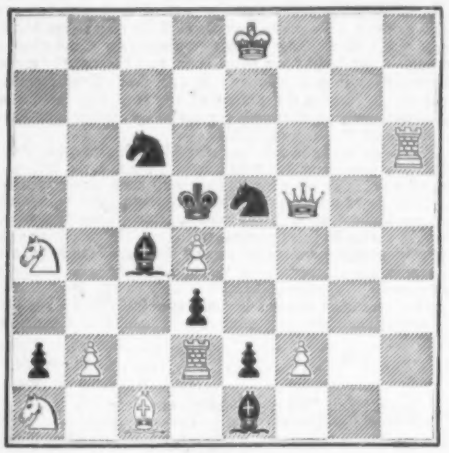
[All contributions intended for this department may be addressed to SAMUEL LOYD, Elizabeth, N. J.]

PROBLEM No. 58.

[First Prize Problem of the Cleveland *Voice* Tourney.]

BY F. W. MARTINDALE, PETERSBORO, N. Y.

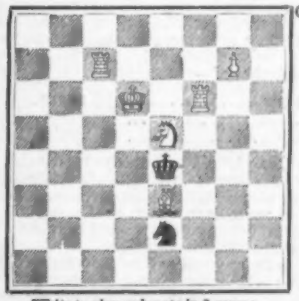
Black.



White.

White to play and mate in three moves.

EUGENE DELMAR, OF NEW YORK.



White to play and mate in 2 moves.
By W. A. BALLANTINE.

YOUTHFUL as the subject of our sketch may appear in years, he has been looked upon as one of the veteran players for a score of years, and is known throughout the chess world as one of our strongest and most brilliant players. He has carried off the highest honors in many prominent tournaments, and has shown great skill in games by correspondence and consultation matches, as proven by the recent contests in which he participated. In the *Clipper* Tournament he received the second prize by a very close score.

We remember having seen the following specimen of his skill at composing many years ago, but not having seen any of his later works cannot state what progress he has made:

ENIGMA No. 25.—BY EUGENE DELMAR.

White.—K on Q B 4, R K B 3, B K Kt 2, P Q 4.
Black.—K on K 5.
White to play and mate in two moves.

We select a game just won by Mr. Delmar in the Correspondence Tourney of the Hartford *Sunday Globe*, an interesting tournament inaugurated by the enterprising chess editors of that paper, the terms of which, if we are not mistaken, being that every player is to contest two games with every other player, and the winners of the most games to receive the highest prizes.

The following diagram shows the latest returns, and also pretty clearly indicates the probable winners, which seems very favorable to the subject of our sketch:

	Anderson	Shields	Delmar	Atkinson	Hawkins	Orchard	Berry	Wurm	Brown	Games won.
Anderson		1		½				1		2½
Shields	1								1	2
Delmar	2	2		2		2	1	2	1½	12½
Atkinson	1½	1							1	3½
Hawkins										0
Orchard		1								1
Berry	2	2	1	2	1				2	10
Wurm	1	1				2				4
Brown			½							½
Games lost	7½	8	1½	4½	1	4	1	3	5½	36

OMAI, the native of Otaheite, learned to play chess while in London, and became a considerable proficient in the game, in which he once defeated Mr. Baretti; a circumstance only to be noticed on account of its having been the cause of breaking off an acquaintance between that gentleman and Dr. Johnson, which had existed for upward of thirty years. The Doctor used frequently to rally Mr. Baretti on the subject, and sometimes unmercifully.

"At length," says Mr. Baretti, "he pushed his banter on at such a rate that he chafed me, and made me so angry, that, not being able to put a stop to it, I snatched up my hat and stick and quitted him in a most choleric mood."

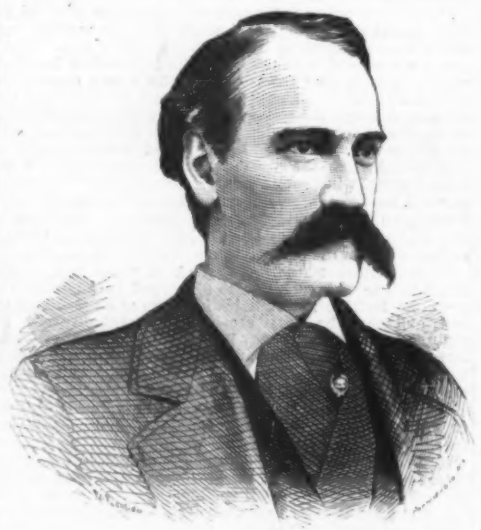
When the Doctor heard how much he had offended his friend, he invited him to his house; but Mr. Baretti was then in the country, and before he returned to town Dr. Johnson was dead.

SHIELDS AND DELMAR.

PLAYED in the Correspondence Tourney of the Hartford *Sunday Globe* chess column, between Rev. D. H. Shields, of Spring City, Penn., and Mr. E. Delmar, of New York.

[EVANS GAMBIT.]

Rev. D. N. SHIELDS. WHITE.	Mr. E. DELMAR. BLACK.
1. P to K 4	1. P to K 4
2. Kt to K B 3	2. Kt to Q B 3
3. B to B 4	3. B to B 4
4. P to Q Kt 4	4. B x Kt P
5. P to B 3	5. B to R 4
6. P to Q 4	6. P x P
7. Castles.	7. P x P
8. Q to Kt 3	8. Q to B 3
9. P to K 5	9. Q to Kt 3
10. Kt x P	10. K Kt to K 2
11. Kt to K 2	11. P to Kt 4
12. B to Q 3	12. Q to K 3
13. Q to Kt 2	13. Kt to Kt 3
14. B to K B 4	14. Castles.
15. Q R to Q sq	15. P to Q R 3
16. B to Kt 3	16. B to Kt 3
17. Kt to Kt 5	17. Q to K 3
18. B to K 4	18. Q x Kt
19. B x Q Kt	19. Q P x B
20. K to R sq	20. B to K 3
21. P to K B 4	21. Q to R 4
22. B to K sq	22. Q R to Q sq
23. R x R	23. R x R
24. Kt to Kt 3	24. Q to Q 8
25. B to B 3	25. Kt x K B P
26. Q to Kt 4	26. Kt to Q 6
27. R x Q	27. Kt to B 7 ch
28. K to Kt sq	28. R x R ch
Resigns.	



EUGENE DELMAR.

THE CLEVELAND VOICE PROBLEM TOURNEY.

WE present to our readers this week the winning problems of the recent tournament of the Cleveland *Sunday Voice*. Mr. George Carpenter, the well-known problemist and critic, acted as umpire, and had to decide upon the relative merits of ninety-one problems which were sent in competition for the three prizes which Mr. McKim had offered for the three best single problems. The first prize was awarded to F. W. Martindale, who, it is well to remark, would also have received the second prize if it had not been stipulated that no competitor should receive more than one prize. The second prize was therefore awarded to Samuel Loyd, and the third prize to W. A. Shinkman, of Grand Rapids, Mich., for the following clever position:

ENIGMA No. 26.—BY W. A. SHINKMAN.

Third Prize in the Cleveland *Voice* Tourney.

White.—K on K Kt 7, Q K R sq, B Q 6, Kt K 7, Ps Q B 5, K 2 and K R 6.
Black.—K on K 3, B Q B 5, Kts Q R 2, K B 7, Ps Q Kt 2, Q 2, Q 5, K 6, K Kt 3, 4, and 5
White to play and mate in three moves.

More than a dozen noted composers received *honorable mention* for the merit of their compositions.

Do not be alarmed about the state of your adversary's health when, after losing two or three games, he complains of having a bad headache, or of feeling very unwell. If he should win the next game you will probably hear no more of it.—*Richard Penn.*

MR. COXE, who was in Russia in 1772, says:

"Chess is so common in Russia that, during our continuance at Moscow, I scarcely entered into any company where parties were not engaged in that diversion, and I very frequently observed, in my passage through the streets, the tradesmen and common people playing it before the doors of their shops or houses."

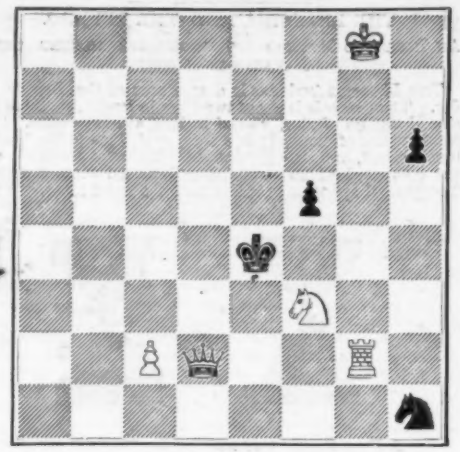
RICHARD PENN says:—"Remember the Italian proverb, 'Never make a good move without looking out for a better.' Even if your adversary should leave his Queen *en prise*, do not snap hastily at it. The Queen is a good thing to win, but the game is better. The dullest way of winning is better than the most brilliant way of losing."

PROBLEM No. 59.

[Second Prize Problem of the Cleveland *Voice* Tourney.]

BY SAMUEL LOYD, ELIZABETH, N. J.

Black.



White.

White to play and mate in three moves.

SOLUTIONS TO PROBLEMS.

No. 52.—BY ALONZO TOWNSEND.

(The Queen being white.)

WHITE.	BLACK.
1. K to Kt sq	1. P to Kt 7
2. Kt to B 6	2. K x either Kt
3. Q mates.	
	1. K to Kt 5
2. Q to Kt sq ch	2. K moves
3. Q mates.	

No. 53.—BY SAMUEL LOYD.

WHITE.	BLACK.
1. R to K B 8	1. Kt x R
2. B to K B 5	2. Kt moves
3. B x Kt	3. B moves
4. P to Kt 4	4. B moves
5. B mates.	
	1. Kt to K 4
2. K to K 2	2. Kt to B 2
3. R x Kt	3. B to B 5
4. R x B	4. K to Kt 8
5. R to B sq mate.	

LETTER "R."—BY REV. L. W. MUDGE.

WHITE.	BLACK.
1. Q to R 4	1. Any move
2. Q mates.	

ENIGMA No. 16.—BY S. LOYD.

WHITE.	BLACK.
1. B to Q R 8	1. P to Kt 4
2. Q to Kt 7	2. Any move
3. Q to K R sq mate.	

ENIGMA No. 17.—BY S. LOYD.

WHITE.	BLACK.
1. P x B (Kts)	1. R to R 3
2. Kt to Kt 6	2. Moves
3. Q mates.	

ENIGMA No. 18.—By S. LOYD.

WHITE.	BLACK.
1. Q to Q R 8	1. P to Kt 7
2. Q to K Kt 8	2. P to Q 3
3. Q to Q 5	3. K x either P
4. Q mates.	

ENIGMA No. 19.—BY S. LOYD.

WHITE.	BLACK.
1. B x R P	1. P x B dis ch
2. P to Kt 7	2. Any move
3. Q to Q B 8 ch	3. Q x Q
4. P x Q mating.	

ENIGMA No. 20.—BY S. LOYD.

WHITE.	BLACK.
1. P to Q Kt 4	1. R to B 4 ch
2. P x R	2. P to R 7
3. P to B 6	3. B to B 2
4. P x Kt P	4. Any move
5. P x Kt mating.	

MORALITY OF CHESS.

POPE INNOCENT, who was raised to the Pontificate in the year 1198, wrote an essay upon the morals of chess, which disposes of the theological problem that is so vexing our clergy in the following summary way:

"This whole world is like a chess board, one point of which is white, the other black, because of the double state of life and death, grace and sin. The *familie* of this chess board are like the men of this world: they all come out of one box and are placed in different situations in this world, and have different appellations. One is called King, another Queen, the third Rook, the fourth Knight, the fifth Bishop, sixth Pawn. The conditions of the game are that one takes the other, and when the game is finished, as they all came out of one box, they are put into the same place together. Neither is there any difference between the King and the poor Pawn; and it often happens that when one *familie* is thus put by to rest in its box, the King lies at the bottom, just as the great will find themselves in their transit from this world to hell."